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McLean County Solid Waste Management System Analysis

Roy F. Weston, Inc., West Chester, PA

Prepared for

Illinois Inst for Environment Quality, Chicago

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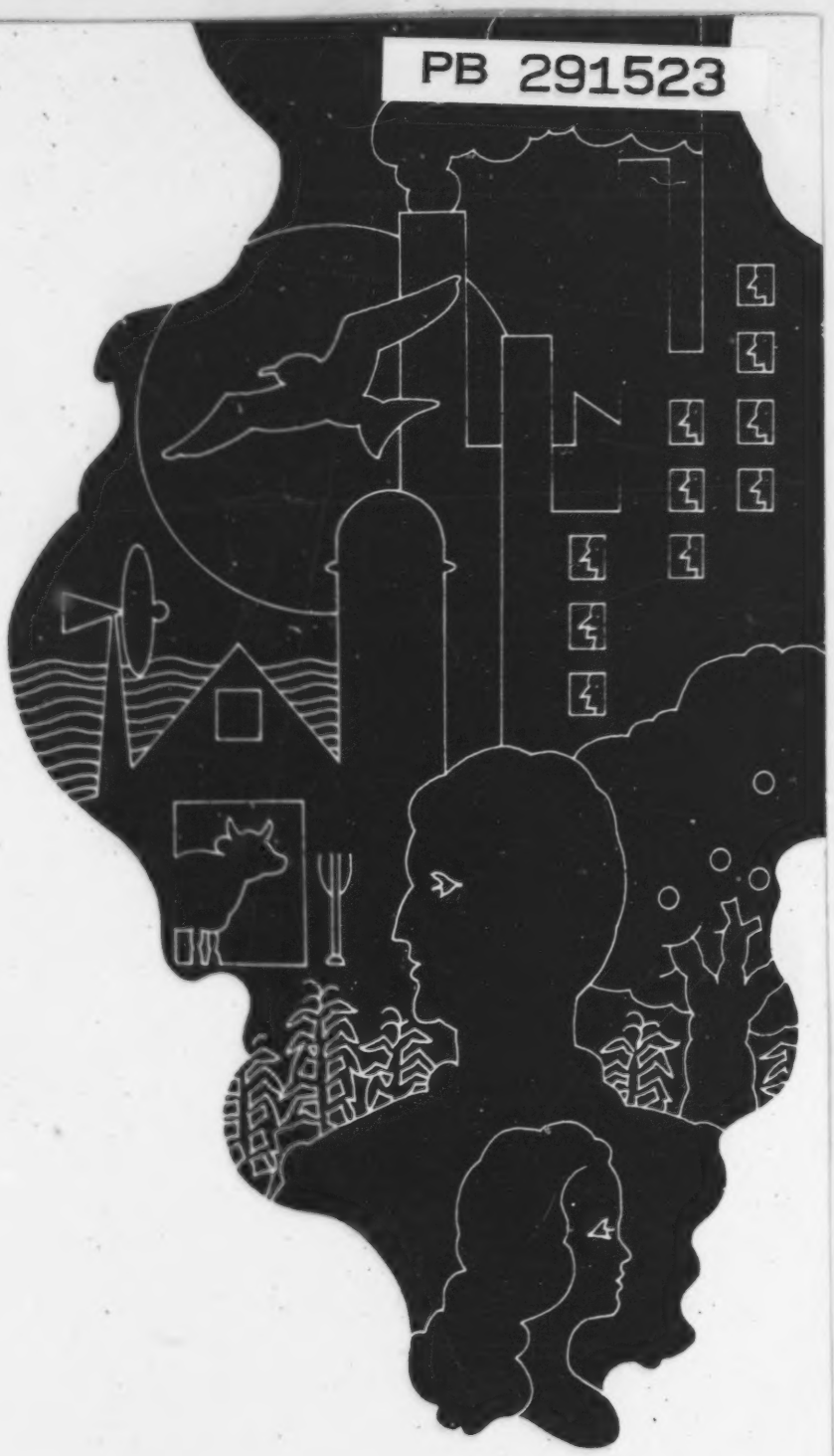

McLEAN COUNTY
SOLID WASTE MANAGEMENT SYSTEM ANALYSIS

Document No. 74-8

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MC LEAN COUNTY

SOLID WASTE MANAGEMENT

SYSTEM ANALYSIS

Roy F. Weston, Inc.

(IIEQ Document No. 74 - 8)

Project No. 40.001

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June, 1974

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SOLID WASTE
MANAGEMENT PLANNING

The Need for Advance Planning in Illinois

In July, 1970, the Illinois General Assembly passed the Illinois Environmental Protection Act. This law expresses the determination of the people to improve the quality of the environment in Illinois. The Act addresses problems of air, water, land and noise pollution.

In 1973, the Illinois Pollution Control Board adopted new regulations for sanitary landfills. These regulations are enforced by the Illinois Environmental Protection Agency. The permit and inspection provisions established under these regulations are among the most comprehensive and vigorous in the United States. Each landfill operator is required to apply for a permit by April 27, 1974. The expense of meeting Illinois design and operating standards has and probably will cause some marginal landfill operations to close, thereby eliminating some environmentally unacceptable, but convenient, disposal sites.

The dwindling number of solid waste disposal sites has caused concern among municipal officials and private solid waste companies. Efforts to aquire new sites have often been thwarted by citizens who recognize the need for such facilities, but would rather see them located somewhere else.

The increased costs associated with everything these days have strained municipal budgets. Solid waste management is a large budget item. Elected officials are asking: Can this be reduced?

Over half of the solid waste in Illinois is managed by private companies. Their costs are increasing, and so are the rates charged to their clients. Public officials are asking: What is the cost of solid waste management? Should we go into business for ourselves?

In 1973, the energy crisis reinforced the long-standing argument by

environmentalists that something should be done to recover the resources going into solid waste. Solid waste managers now must cope with the added complexities of unproven recovery systems and an uncertain market for recovered commodities.

These and other pressing problems require planning. This study provides a basis for that planning by examining the economics of current solid waste management practices and proposed regional management strategies.

State Solid Waste Plan

The State Solid Waste Management Planning Project will examine the solid waste needs of Illinois and make recommendations as to actions that can be taken by the State to improve solid waste management generally. The Solid Waste Management Task Force of the Illinois Institute for Environmental Quality recognized from the start that solid waste management is a local responsibility and is subject to the specific desires of the people as to the services desired and the manner of satisfying these desires. Consequently, the task force suggested that the principal thrust of the State planning project should be to assist the work of local and regional planners who must prepare the specific recommendations for local officials.

This report is an analysis by the State and its consultants of several alternatives available to a specific region. Basic data used in the analysis was gathered by the regional planners, processed by the consultants, and rechecked by the regional planners. Elsewhere in the State plan, the planner will find reference data on the natural features of the State which will have an impact on solid waste management activities.

The Analytical Process

People and their activities produce solid waste. The first step in the planning procedure was to determine population and employment. Basic population projection data was generated by Argonne National Laboratory using historic census data and a predictive model. These projections were checked by the regional planner using local data and projections by the Illinois Office of Planning and Analysis (OPA). Tables 1 and 3 show examples of population and employment projections. Employment data was taken from the

Table 1

PROJECTED POPULATION EXAMPLE

LOCATION	1970	1975	1980	1985	1990	1995	2000
City A	305	305	350	360	390	400	410
City B	39,992	44,500	48,500	51,400	54,000	57,100	59,800
City C	2,435	2,780	3,010	3,230	3,440	3,690	3,910
City D	26,396	27,900	34,400	39,100	43,800	49,000	54,100
SUB TOTAL	69,128	75,385	86,260	94,090	101,630	110,190	118,220
UNINCORPORATED	21,754	23,400	24,200	24,800	25,300	25,900	26,400
COUNTY TOTAL	90,882	98,785	110,460	118,890	126,930	136,090	144,620

Table 2

AN ILLUSTRATION METHOD OF MUNICIPAL SOLID WASTE GENERATION

(1) Political Subdivision	(2) 1970 Population	(3) Area $(mi.^2)$	(4) Population Density (2) ÷ (3)	(5) Log (4)	(6) 1.54 X (5)	(7) Generation Factor (6) - 0.68 #/cap /day	(8) Collection Rate (2) x (7) #/day	(9) Collection Rate (8) ÷ 285.7 ton/week
City A	305	0.17	1,794	3.25	5.01	4.33	1,320	4.6
City B	39,992	11.37	3,517	3.55	5.46	4.78	191,161	699.
City C	2,435	1.28	1,902	3.28	5.05	4.37	10,641	37.
City D	26,396	6.06	4,356	3.64	5.60	4.92	129,868	455.
Co. Remainder	21,358	1,157.	18.7	-	-	3.4	72,617	254.

Table 3

AN EXAMPLE OF THE EMPLOYMENT PROJECTIONS

SIC		1971	1975	1980	1985	1990	1995	2000
City B	207	1,000	1,000	1,000	1,000	1,000	1,000	1,000
	2432	25	29	31	35	36	40	42
	3272	3	0	0	0	0	0	0
	358	1,500	2,470	2,750	3,020	3,220	3,630	4,010
City C	243	15	15	15	15	15	15	15
	271	4	1	0	0	0	0	0
City D	275	15	21	27	32	37	43	49
	278	60	79	100	140	170	210	240
	301	225	225	225	225	225	225	225
	327	32	32	35	35	35	35	35

Illinois Manufacturers' Association Directory as an historic data base. Employment projections are expressed in 3- and 4- digit Standard Industrial Classification (SIC) code (Table B-1, Appendix B).

Approved population projections are then multiplied by waste generation factors to give the municipal solid waste load (i.e. the residential and commercial wastes generated within a community).

Table 2 is an example of a tabular solution in which population is translated into a solid waste generation rate. (A more detailed explanation of the columns and the computational method is contained on Page B-1, Appendix B). Similarly, Table 4 gives a sample calculation in which employment is translated into tons of industrial wastes. The conversion factors (Table B-1, Appendix B) for converting employment data into tons of waste were derived by the consultant from data supplied by the USEPA. Table 5 shows, where there is no centrally located municipality, how the residential waste from unincorporated areas is allocated (on the basis of percentage of area) and combined with municipal and industrial wastes for the purpose of subsequent analyses. Wastes from unincorporated areas are considered to be located at the centroid of the township.

For long-term planning, consideration must be given to the annual change in generation rates. The computational methodology is shown on Table 6. A 2% and 3% per year increase in the generation factor was used for cities with more than 10,000 people and less than 10,000 people respectively.

Total waste quantities for the present (1973) and a future date (1990) are presented on Table 7. These waste quantities are, in turn, provided as input to a computerized model. The computer then determines the cost of hauling waste from the centroid of each source to each specified processing or disposal site. Transportation costs are added to site annual operating costs to determine a total annual system cost. It is within the capability of the computer model, if it is so instructed, to select the combinations of sources, processing facilities and ultimate sites which given the least (optimum) system cost.

Table 4

EXAMPLE OF INDUSTRIAL WASTE LOADING CALCULATION

(1) Location of Political Subdivision	(2) SIC Code	(3) Number of Employees in 1971	(4) Generation Factor (Ton/Empl/Yr)	(5) Production Rate (Ton/Yr) (3) x (4)	(6) Production Rate (Tons/Week) (5) ÷ 52	(7) Total Industrial Waste For Each Source (Ton/Week)
City A						0
City B	207	1,000	3.3	3,300.	63.4	
	2432	25	232.	5,800.	111.5	
	3272	9	154.	1,310	26.1	
	358	1,500	1.5	2,250	42.2	243.2
City C	243	15	21.7	3 325.5	6.3	6.3
City D	275	15	1.1	16.5	-	
	278	60	2.6	156.	3	
	301	225	3.7	833.	16	
	327	32	15.	480.	9.2	28.2

Table 5

EXAMPLE OF COMPOSITE LOADING SHEET FOR BASE YEAR - 1973

Source Name	I.D#	SIC Load (Ton/Week)	Municipal Load (Ton/Week)	Area for Division of County Remainder (Miles)^2	Load due to County Remainder (Ton/Week)	Total Load (Ton/Week)
City A	101	-	4.6	9.7	54.6	59.2
City B	102	243.2	699.	10.	56.3	998.5
City C	103	6.3	37.	10.4	58.6	101.9
City D	104	28.2	455.	15.	84.5	567.7
				45.1	253.98	
County Remainder -		-	254			1727.3

Table 6

AN EXAMPLE OF THE COMPOSITE SHEET FOR WASTE LOADS (Ton/Week) FOR 1990

Source Name	I.D.#	1990 Industrial Load (Ton/Week)	1970 Generation Rate (#/cap./day)	% Increase Per Year	Total % Increase	1990 Generation Factor (#/cap./day)	1990 Municipal Waste Loads (Ton/Week)	County Area Factor	County Remainder Based on Area (Ton/Week)	1990 Total Waste Loads (Ton/Week)
City A	101	-	4.33	3	60	6.9	9.4	36	94.3	103.7
City B	102	360	4.78	2	40	6.35	1264.	48	125.7	1389.7
City C	103	6	4.37	3	60	6.99	84.3	64	167.7	252.
City D	104	36	4.92	2	40	7.87	1207.	36	94.3	1301.3
County Remainder			3.4	3	60	5.44	482	184		3046.7

Table 7

EXAMPLE OF THE STUDY PERIOD SOURCE INVENTORY

SOURCE NAME	SOURCE ID NO.	1973 VALUES QUANTITY (Tons/Week)	1990 VALUE QUANTITY (Tons/Week)
City A	101	59.2	103.7
City B	102	998.5	1389.7
City C	103	101.9	252.
City D	104	567.7	1301.3

In addition to sources and waste quantities, the computer must be given cost parameters for transportation and for the operation of the solid waste management system specified. Unit costs for the disposal systems tend to be lower as the quantities increase. Such variable cost factors are best described by cost curves which were incorporated into the computer input. These cost curves are shown in Figs. B-1 and B-2, Appendix B.

In developing the planning factors and cost curves, the consultant was faced with the problem of picking a finite value for a given function when, in actuality, that function could be described by a range of values. The values given here are neither the highest nor the lowest, but an estimate of current conditions. They were adjusted to 1973 cost levels using the Engineering News-Record construction cost index. Where appropriate, assumptions are listed.

Computations do not include the cost of solid waste collection. It is assumed that, regardless of the management system used, the waste must be collected. Whether it is collected once a week or twice a week, at the curb or at the back door, in plastic bags or in 32 gallon cans, are matters of local preference. The alternatives addressed in this study include the cost of moving from the centroid of the collection area to an intermediate or final disposal site.

Aside from taking the drudgery out of the thousands of calculations required, the computerized model permits the planners to examine a range of management alternatives. The strategies thus examined and reported here were proposed and analyzed by the regional planner with assistance from the State's consultants.

Resource Recovery

These analyses take a conservative view of the economics of resource recovery alternatives. As of March, 1974, there were no large scale resource recovery systems operating in the United States. Certain demonstrations projects are operating successfully in Franklin, Ohio and St. Louis, Missouri. Larger systems have been designed and several are under construction. We can

predict operating and capital costs better than we can predict the off-setting revenues from the sale of recoverable resources. Table 9 gives recent prices for the secondary materials present in typical municipal waste. These prices are subject to the usual variations of the commodities market, as well as regional variations in transportation costs. Table 10 describes eight levels of resource recovery activities and the expected revenue (based on Table 9 prices). The decision to adopt a resource recovery system will entail an evaluation of the risk involved in the fluctuating market values.

Uses of This Report

The results of this analysis are intended to assist the regional planner in preparing recommendations for local decision makers. The analytical techniques used are based upon averages and generalized planning factors developed in 1973 and cannot be expected to reflect the exact local cost situation. The usefulness of this regional analysis is to show the relative economic merits of alternate management systems, thus enabling the planner to separate the most feasible alternatives from the least feasible.

This report includes basic data, planning factors, and sample calculations so that the regional planner can make specific adjustments later on. It is to be emphasized that the least cost solution is not necessarily the best. The recommended solution will be that which combines economy with regional desires and constraints. To prepare such recommendations is the task of the regional planner.

Future Planning

It is expected that regional planners will need to up-date their plans and to consider other strategies. It is the intention of the Illinois Institute for Environmental Quality to maintain the capability for providing these regional analyses.

TABLE 9

RESOURCE RECOVERY VALUE FOR FERROUS AND NONFERROUS METALS, GLASS, FIBERS AND HEAT VALUE

Materials Recovered	Conc. In MSW (%)	Recovery (%)	T /100T MSW	Delivered Price	Trans. Charge (5)	Net Credit	Credit $/Ton Of Input Solid Waste
Ferrous Metal (6)	7.5	100	7.5	$56	$ 46	$11.7	$ .82
#2 Bundle	7.5	100	7.5	20 (10-30)	6	10	0.75
Madison (3)	7.5			51	6	14	1.05
Scrap Steel Jan. 73 (4)				86	6	45	
Jan. 74 (4)						80	
Scrap Steel Incinerator Residue			7.5	12 (10-14)	5	7 (5-9)	.53 (.40-.72) (.42 (6))
Aluminum	1.0	100	1.	200	50	150	1.50
Copper Zinc Fraction	.5	100	.5	240	50	190	.95
Copper Scrap (Jan. 73) (4)				860	50	810	
(Jan. 74) (4)				1360	50	1310	
Tin Scrap (Madison (3))				4000	50	3950	
Glass (Sorted by color)	9.	44	4.	16	6	TD	.40
Mixed Glass Fines	9.	70	6.3	5	6	- 1	-0.06
Fourth Forest Pulp	40. (Dry Basis)	45	18.	25	8	17	3.06
Newsprint (July 73) (4)			8	18	8	TD	0.80
(Nov. 73) (4) Separated			8	35	8	27	2.16
(Jan. 74)			8	60	8	52	4.16
Paper (6)			15.			15	2.25
Energy Recovery							
Electric Energy (6)			6.67×10^4 Kwhr.			$.006/Kwhr.	4.00
Shredded Refuse Heat Value (7)			7.5×10^8 Btu/100 Ton			.50¢/M Btu	3.75
Total Combustible	75. (Wet Basis)	100	75.			(1.)	4.95
Combustible After Fiber Recovery	75. (Wet Basis)	66	50.			(2.)	3.3
Synthetic Fuel Oil (6)			4.80×10^8 Btu/Ton			$8-/10^6$ Btu	3.36
Synthetic Fuel Gas (6)			6.7×10^8 Btu/Ton			$.50/10^6$ Btu	3.33
Steam			175	1.90 @ .95/1000#			3.33
			175				

1. Produces 450 Kilowatts-hours of Electricity/Ton, Valued at 1.1 Cent per Kilowatt-hours.
2. Producers 300 " " " " " " " " " " " " "
3. From Madison Wisconsin Shredding and Landfill Operation.
4. Wall Street Journal - January 31, 1974
5. Transport Cost for 1973 Average Used Through-out, Value Fluctuates
6. Resource Recovery - The State of Technology, pg. 25
7. Commonwealth Edison 1974

This Table summarizes the by-product credits that may be realized by reclamation of recyclable materials from a ton of MSW. The credits reflect 1973 conditions and assume reasonable transportation charges to proximate recycling plants; i.e., the credits are based on delivered prices and representative concentrations of the salvaged materials in MSW. Extreme fluctuation can be seen in a one year period. Selection of appropriate value must be based on transport distance and market demand.

Table 10

TABLE OF RESOURCE RECOVERY VALUES FOR VARIOUS SYSTEMS

A. Small operation - magnetic separation of cans
$1.05/Ton of Input Municipal Solid Waste (M.S.W.)

B. Cans and Paper Recovered
$1.05 Cans
3.06 Paper - based on separate collection
$4.11/Ton of Input M.S.W.

C. Cans, Paper, Aluminum, Copper - Zinc Fraction Recovered
$1.05 Cans
3.06 Paper - separate collection
1.50 Aluminum
.95 Copper - Zinc Fraction
$6.56/Ton of Input M.S.W.

D. Cans, Paper, Aluminum, Copper-Zinc, and Fraction Heat Recovery
$1.05/T for Cans
3.06/T for Paper separate collection
1.50/T for Aluminum
.95/T for Copper-Zinc Fraction
3.00/T for Heat Recovery after Fiber Recovery
$9.56/Ton M.S.W. Input

E. Incineration with Residue Recovery. Recover only Steel Cans
$ .53 Cans from incinerator Residue

$ .53/Ton M.S.W

F. Metal Recovery, Heat Recovery, Heat Recovery of Shredded M.S.W.
$1.05/T for Magnetic can separation
1.50/T for Aluminum
.95/T for Copper-Zinc Fraction
3.75/T for Shredded Fuel Value

$7.25/T of Input M.S.W.

G. Incineration with Residue Recovery and Heat Recovery
$ .53/T for Cans from incinerator Residue
1.50/T for Aluminum
.95/T for Copper-Zinc Fraction
4.50/T for Heat Value

$8.00/T for Heat and Material Recovery of M.S.W.

H. Source separation and separate collection of newsprint
$ .80-4.16/Ton of Input Municipal Solid Waste (M.S.W.)

CAUTION: This table shows the value of recovered resources for 8 theoretical recovery systems. It is based on the "credit $/Ton" column of Table 9, and is subject to the conditions and assumptions stated. Tables 9 and 10 may need to be modified to reflect local markets and transportation costs.

MANAGEMENT ALTERNATIVES FOR MC LEAN COUNTY

This report summarizes the data gathered by the McLean County Regional Planning Commission and the solid waste management alternatives developed jointly by the State's consultant, Argonne National Laboratory, and the staff of the planning commission.

The Mc Lean County Regional Planning Commission has identified three major landfill sites which have sufficient capacity to be considered for continued operational purposes. These landfills can handle the entire refuse wasteload collected in the county. The Mc Lean County Landfill, located west of Bloomington, is largest of the three and has an operating capacity of 2,200 ton per week which, if desired, could handle the entire load of the county. Bradds Landfill near Saybrook and the Le Roy Municipal Landfill have smaller operating and ultimate capacities than the Mc Lean County Landfill.

Present Problem

The present need in the county is to update their solid waste plan; to see what improvements can be made to the existing system; and to explore the possibilities of other management alternatives, especially those involving some form of resource recovery. Additionally, the study will consider the possible consequences faced by the county, if any of the existing landfills should be closed.

Computational Methods

Projections of population, employment, and waste loads were calculated using the methods described in Chapter 1. The results are tabulated in Tables 1, 2, and 3 of Appendix A. A summary of geological information for the Mc Lean County Region (Appendix A) provides a general overview of the soil and groundwater conditions and the possible effect of these conditions on sanitary landfill locations.

Short-Term

During the short-term (two to three years) available alternative systems include: optimization of haul; opening and closing of landfills; and the construction of transfer stations. Large processing facilities require at least 3-5 years to plan, design, finance, and construct. Ideally, short-term alternatives will lead logically to desirable long-term solutions.

Alternative 1: Continuation of Existing System

The existing system is analysed in order to see what is happening in the county and to establish a basic system cost. Results are shown on the appropriate diagram. As previously stated, three landfills handle all of the waste generated in the county. The Mc Lean County Landfill handles 90 percent of the waste, and has an expected life of 6 years. The $5.91/Ton county average system cost is reasonable, largely because of the proximity of the waste centroid (Bloomington-Normal) to the disposal site. The diagram shows several overlapping haul routes which are inefficient and should be rerouted. The small waste quantities handled at the Bradd's and Le Roy Landfills result in a very high disposal cost for those facilities ($5.70 and $7.40/Ton respectively versus $1.94/Ton for Mc Lean County Landfill.

Alternative 2: Eliminate Smaller Landfill, Optimize Haul

The previous alternative suggests that a saving would be possible if one of the smaller landfills were eliminated and haul distances optimized. This alternative, therefore,makes use of the present Mc Lean County and Bradd's Landfill sites. The increased use of the Bradd's site thus lowered the unit cost slightly. However, most of the waste (1800 tons/week) moved to the Mc Lean County site. The elimination of overlapping haul routes reduced the total haul cost, as compared with the existing situations. The total system unit cost of $5.76/Ton is only about 3% less than the existing system, and is probably not significant, except to show that small, under-utilized landfills tend

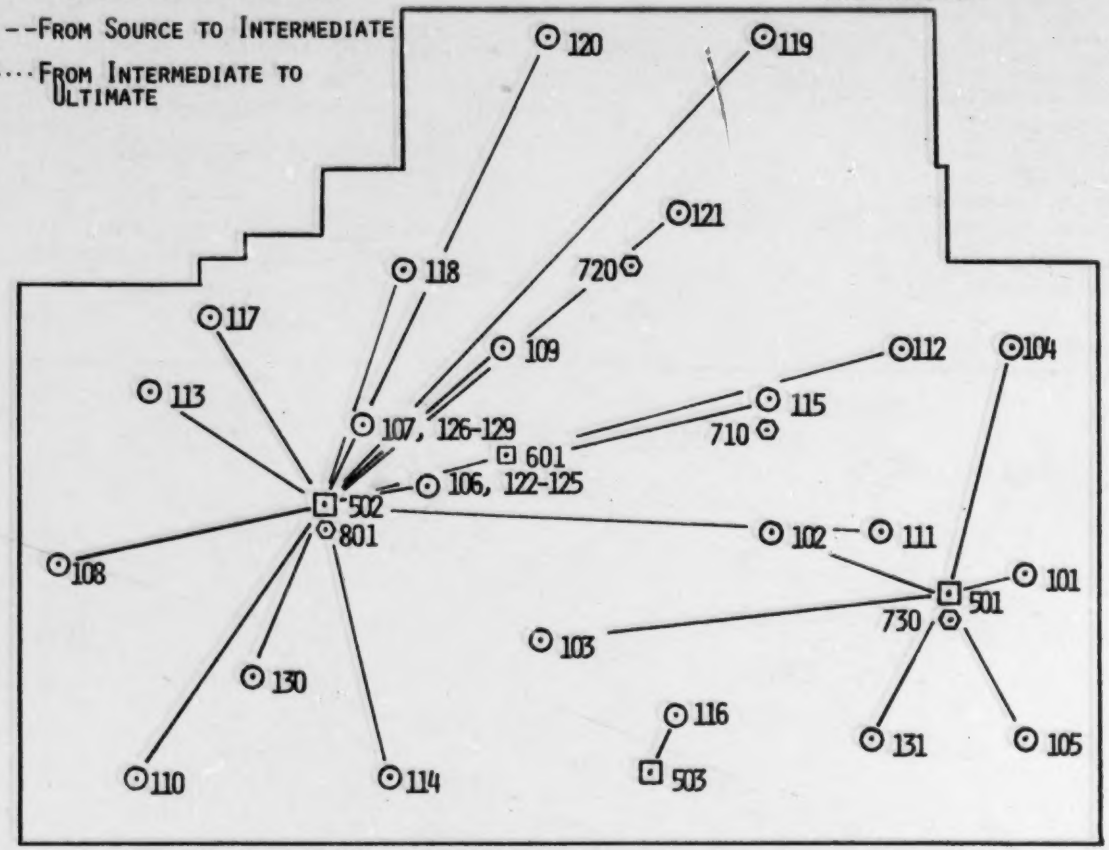
McLean County 1973-1974
Summary of Existing System
Alternative #1

Key:

—— From Source to Ultimate

– – – From Source to Intermediate

····· From Intermediate to Ultimate



Sources

101 - Saybrook
102 - Ellsworth
103 - Downs
104 - Anchor
105 - Belleflower
106 - Bloomington
107 - Normal
108 - Stanford
109 - Towanda
110 - McLean
111 - Arrowsmith
112 - Colfax
113 - Danvers
114 - Heyworth
115 - Cooksville
116 - LeRoy
117 - Carlock
118 - Hudson
119 - Chenoa
120 - Gridley
121 - Lexington
122 to 125 - Bloomington
126 to 129 - Normal
130 - Waste Center #1
131 - Waste Center #2

Intermediate Facilities

710 - Cooksville Transfer
720 - Lexington Transfer
730 - Bradd's Transfer
801 - Compost Plant

Ultimate Facilities

*501 - Bradd's Landfill
*502 - McLean County Landfill
*503 - LeRoy Landfill
601 - Towanda Landfill

*Used for Current Date.

General Haul Cost Assumptions

Packer Haul Cost $4.36/Ton-Hr.
Transfer Haul Cost $1.40/Ton-Hr.

General Cost Summary

Total Facility Annual Cost	$232,100
Total System Haul Cost	365,100
Total System Annual Cost	$597,200
Total System Unit Cost	$5.91/Ton
Tonnage Handled	1945 Tons/Week

This summary describes an evaluation of the present system. The three major sites are listed as recipients of all county generated waste. The quantities of refuse for each source are the result of waste factors generated using population and employment data. The source-site pairings and the facility information provided herein represents data provided by the local planning agency and the IEPA.

The analysis emphasizes the following facts:

1. The small landfills have a high unit cost.
2. A number of haul distances are great.
3. The greatest concentration of the waste is in the Bloomington-Normal area.

Directions for further analysis.

1. Devise areas of service which will provide the shortest haul possible from source to site
2. Consider transfer stations to reduce haul costs.
3. Select future landfill sites as close to the centroid of waste generation as possible.
4. Eliminate one or more of the high unit cost fills.
5. Consider the use of processing facilities to reduce the quantity of waste requiring disposal.

McLean County 1973-1974

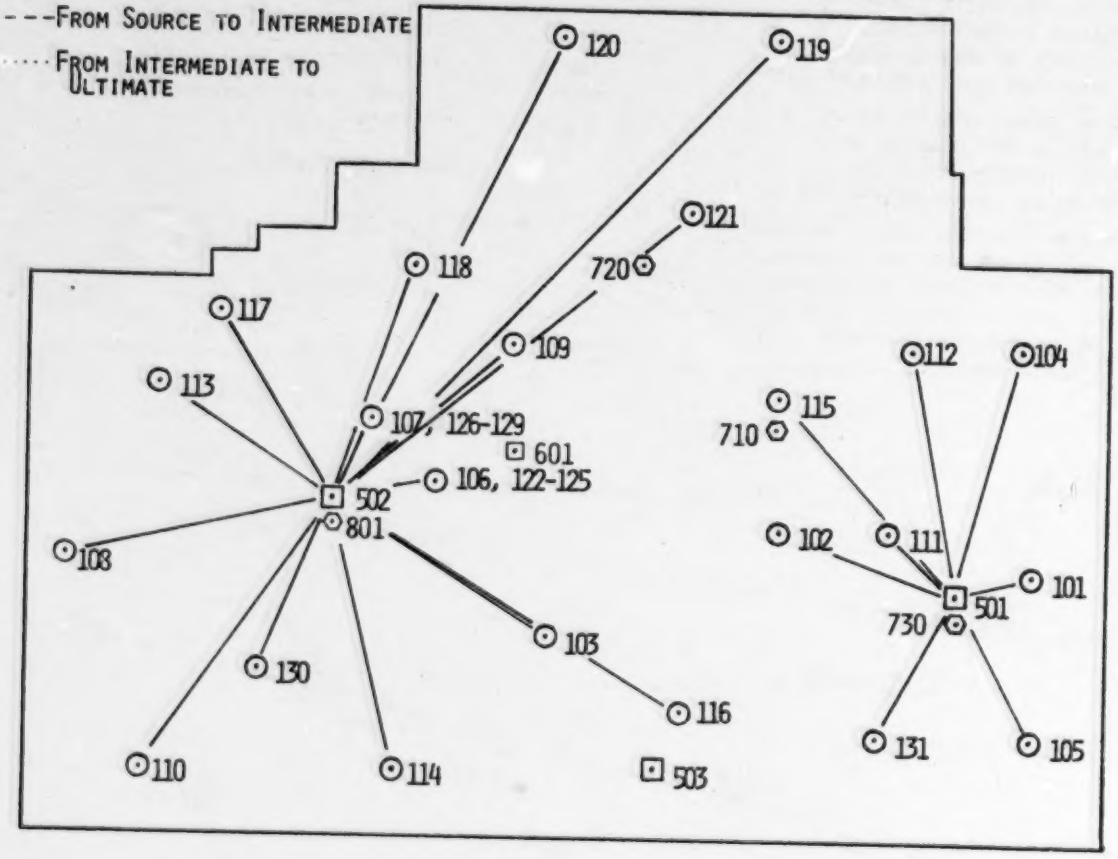
Change of Source-Site Pairings and Drop LeRoy Landfill
Alternative #2

Key:

——From Source to Ultimate

---From Source to Intermediate

·····From Intermediate to Ultimate



Sources

101 - Saybrook
102 - Ellsworth
103 - Downs
104 - Anchor
105 - Belleflower
106 - Bloomington
107 - Normal
108 - Stanford
109 - Towanda
110 - McLean
111 - Arrowsmith
112 - Colfax
113 - Danvers
114 - Heyworth
115 - Cooksville
116 - LeRoy
117 - Carlock
118 - Hudson
119 - Chenoa
120 - Gridley
121 - Lexington
122 to 125 - Bloomington
126 to 129 - Normal
130 - Waste Center #1
131 - Waste Center #2

Intermediate Facilities

710 - Cooksville Transfer
720 - Lexington Transfer
730 - Bradd's Transfer
801 - Compost Plant

Ultimate Facilities

*501 - Bradd's Landfill
*502 - McLean County Landfill
503 - LeRoy Landfill
601 - Towanda Landfill

*Used for Current Date.

General Haul Cost Assumptions

Packer Haul Cost $4.36/Ton-Hr.
Transfer Haul Cost $1.40/Ton-Hr.

General Cost Summary

Total Facility Annual Cost	$218,600
Total System Haul Cost	363,600
Total System Annual Cost	$582,200
Total System Unit Cost	$5.76/Ton
Tonnage Handled	1945 Tons/Week

This summary describes the system resulting from a careful consolidation of waste service areas and the elimination of a landfill operating at high unit costs. The realignment of hauling routes eliminates overlap but not excessive haul distances as previously reported.

The analysis emphasizes the following facts:

1. Some haul routes are still exceedingly long.
2. The smallest landfill will operate at high unit cost.
3. Total cost reductions are produced through reduced haul and disposal costs.

Directions for further analysis:

1. Consider the utilization of a transfer station to reduce haul costs. (The greatest benefit resulting from the use of transfer stations is the greater time or availability of collection trucking for the actual collection function).
2. Consider the use of processing facilities to reduce the quantity of waste requiring disposal.

to increase the system cost and must charge a high fee to their users.

Alternative 3: Two Landfills and a Transfer Station

The saving observed in Alternative 2 suggests that further economies may be possible by constructing a transfer station to receive wastes from the communities in the northeastern portion of the county. The diagram shows that a small saving in haul cost can be achieved, but that the saving is more than offset by the increase in facility cost (because of the added cost of the transfer station). Here again, the cost increase over the existing system is small ($6.11 versus $5.91) and would probably not be significant unless there was a large increase in the cost of operating collection vehicles. The model selected the longer haul to the Mc Lean County landfill because of the lower disposal cost at the larger facility.

Alternative 4: One Landfill and a Transfer Station

The previous alternative suggests that the elimination of the smaller landfill and greater utilization of the transfer facility might lead to a total system saving. The diagram shows the use of a transfer station at Cooksville with all waste moving to the Mc Lean County site. The reduction in the facility cost was matched by the increase in haul cost, with the system unit cost virtually unchanged. This alternative, in the future, would be less attractive if haul costs increase or more attractive if a resource recovery facility were opened near the Mc Lean County landfill site.

Summary of Short Term Alternatives

The relatively small variation between alternatives emphasizes the importance of the Mc Lean County landfill to the system. There is an unmistakable advantage to having a large disposal site (Mc Lean County landfill) near the center of the principal waste source (Bloomington-Normal). If for any reason this site should be closed, another equally accessible site should be found.

McLean County 1973-1974

Two Landfills and a Transfer at Cooksville

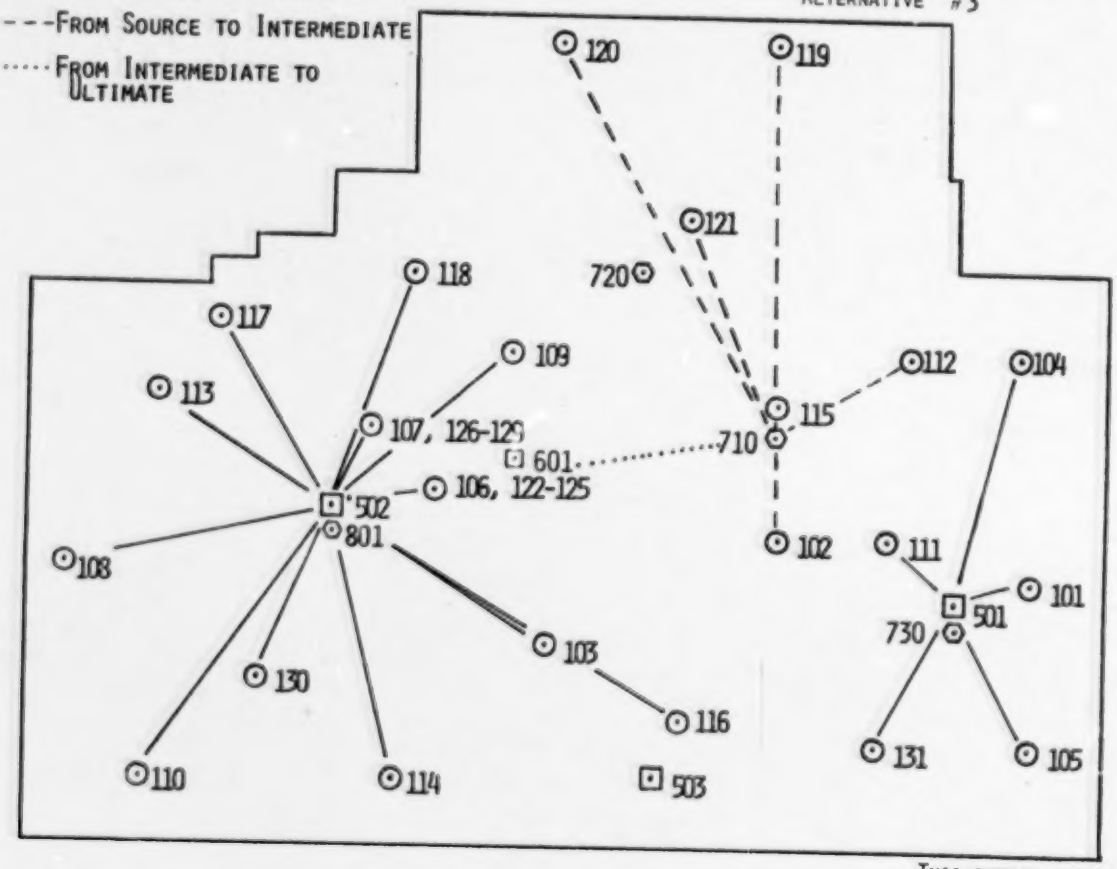
Alternative #3

Key:

——From Source to Ultimate

- - -From Source to Intermediate

·····From Intermediate to Ultimate



Sources

101 - Saybrook
102 - Ellsworth
103 - Downs
104 - Anchor
105 - Belleflower
106 - Bloomington
107 - Normal
108 - Stanford
109 - Towanda
110 - McLean
111 - Arrowsmith
112 - Colfax
113 - Danvers
114 - Heyworth
115 - Cooksville
116 - LeRoy
117 - Carlock
118 - Hudson
119 - Chenoa
120 - Gridley
121 - Lexington
122 to 125 - Bloomington
126 to 129 - Normal
130 - Waste Center #1
131 - Waste Center #2

Intermediate Facilities

*710 - Cooksville Transfer
720 - Lexington Transfer
730 - Bradd's Transfer
801 - Compost Plant

Ultimate Facilities

*501 - Bradd's Landfill
*502 - McLean County Landfill
503 - LeRoy Landfill
601 - Towanda Landfill

*Used for Current Date.

This summary describes a system incorporating a transfer station to reduce haul costs. (which provides additional collection time to each using vehicle). The transfer station was so located as to eliminate any haul of over 19 miles within the county. Transferred waste would be delivered to landfill #502 for disposal.

The analysis emphasizes the following facts:

1. Annual haul costs are reduced
2. The increased facility cost (transfer station) resulted in a slightly higher total annual cost.

Directions for further analysis:

1. Consider the applicability of closing landfill #501, using a single landfill and a transfer station.
2. Consider the use of processing facilities to reduce the quantity of waste requiring haul or disposal.

General Haul Cost Assumptions

Packer Haul Cost	$4.36/Ton-Hr.
Transfer Haul Cost	$1.40/Ton-Hr.

General Cost Summary

Total Facility Annual Cost	$262,100
Total System Haul Cost	356,200
Total System Annual Cost	$618,300
Total System Annual Unit Cost	$6.11/Ton
Tonnage Handled	1945 Tons/Week

McLean County 1973-1974

One Landfill: The McLean County & Transfer Station at Cooksville

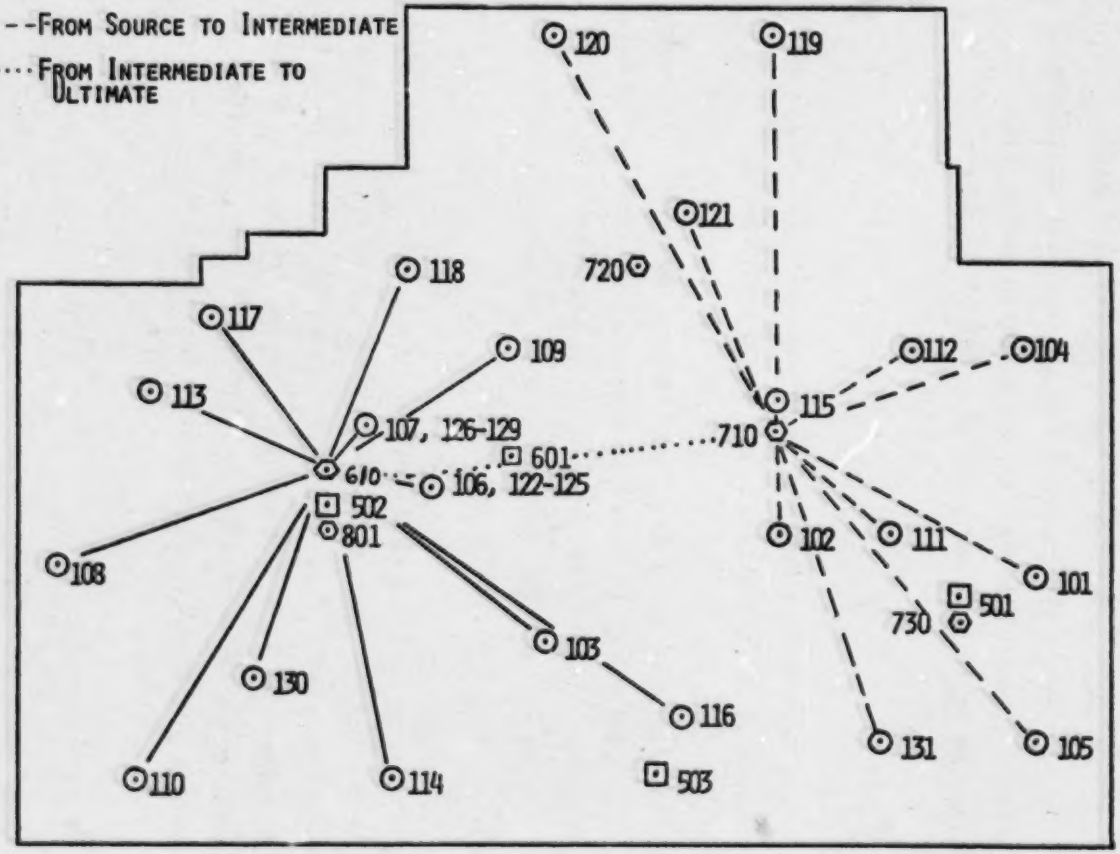
Alternative #4

Key:

—— From Source to Ultimate

- - - From Source to Intermediate

····· From Intermediate to Ultimate



Sources

101 - Saybrook	113 - Danvers
102 - Ellsworth	114 - Heyworth
103 - Downs	115 - Cooksville
104 - Anchor	116 - LeRoy
105 - Belleflower	117 - Carlock
106 - Bloomington	118 - Hudson
107 - Normal	119 - Chenoa
108 - Stanford	120 - Gridley
109 - Towanda	121 - Lexington
110 - McLean	122 to 125 - Bloomington
111 - Arrowsmith	126 to 129 - Normal
112 - Colfax	130 - Waste Center #1
	131 - Waste Center #2

Intermediate Facilities

* 710 - Cooksville Transfer
720 - Lexington Transfer
730 - Bradd's Transfer
801 - Compost Plant
610 - Resource Recovery

Ultimate Facilities

501 - Bradd's Landfill
* 502 - McLean County Landfill
503 - LeRoy Landfill
601 - Towanda Landfill

*Used for Current Date.

General Haul Cost Assumptions

Packer Haul Cost $4.36/Ton-Hr.
Transfer Haul Cost $1.40/Ton-Hr.

General Cost Summary

Total Facility Annual Cost	$236,000
Total System Haul Cost	378,700
Total System Annual Cost	$614,700
Total System Unit Cost	$6.08/Ton
Tonnage Handled	1945 Tons/Week

This summary describes a system utilizing a single landfill with the addition of a transfer station to reduce haul distances to the site.

The analysis emphasizes the following facts:

1. Total annual costs for a single landfill/transfer station combination are close to those of the two landfill concept of alternative #2.
2. Some communities would have greater use of their collection vehicles, because of the minimized haul distances established.
3. A single landfill without a supporting transfer station would probably result in many additional costs, both direct and indirect for the outlying communities.

Directions for further analysis:

1. Two landfills may reduce total system costs further if the second site is placed strategically.
2. Consider the use of processing facilities to reduce the quantity of waste requiring haul or disposal.

Despite the reasonable system cost ($5.76/ton) calculated in Alternative 2, the fact remains that communities such as Chenoa and Gridley are facing high unit haul costs due to their remote location. A possible solution can be found in a variation of Alternative 3 in which a small landfill is opened in the vicinity of Cooksville. The cost to the users of this landfill would be about $10.00/ton, which is no saving. The reason for this high unit cost is the under-utilization of the personnel and equipment who, in this case, are handling only 190 tons/week. A solution used in other counties is to operate the landfill one or two days per week only, thereby freeing the equipment and operators for part-time employment elsewhere. Special provisions must be applied to provide proper site maintenance. The exact saving is difficult to estimate. One such landfill (a special case operation) is operating in Illinois for $12,000/year (as opposed to $44,000/year for a 5-day/week operation). It is conceivable that with planning the more remote communities could thus be served for a unit cost on the order of $7.50/ton.

Long Term Analysis

Sanitary landfilling is a definite long-term possibility for a region with as much open agricultural land as Mc Lean County. Assuming a 20-foot fill depth, the total land requirement for the 17-year period (1973-1990) would be approximately 188 acres. Because of the high value of Central Illinois farmland it is important to note that no more than half of this acreage would be required at one time and that with proper engineering the land can be returned to agricultural production when the fill is completed.

The need for a decision on a long-term solution is indicated by Table 2-1. If the Mc Lean County landfill were closed and all waste was diverted to the Bradd and Le Roy sites, those facilities would be filled in 2.6 years. Allowing two years lead-time for opening a new landfill suggests a decision date of early 1975. In any event, a decision to open a new landfill must be made in 1978.

Table 2-1 Decision Dates for Long-Term Solutions

Facility	Present Tons/wk. Fill Rate	Tons Ultimate Fill Capacity	Years Remaining	Crisis Date	Decision Date
Bradd's	105	77,500	14	1987	1985
Mc Lean	1786	684,000	7.4	1980	1978
Le Roy	54	186,000	66	-	-
Bradd's and Le Roy (McLean closed)	1945	263,500	2.6	1977	1975

Other long-term alternatives such as incineration or resource recovery require less land and offer environmental advantages which may have strong public support. The lead-time for the design, financing, construction and start-up of such facilities will be from 2 to 5 years.

Alternative 5: Landfill, Transfer Station, and Resource Recovery

Alternative 5 would lead eventually to a heat recovery system which would be built in the Bloomington-Normal area. The site would be located in a commercial or industrial area where steam could be supplied to a market. The non-combustible residue (about 15%) from the facility would be disposed of at the Mc Lean County landfill.

If, for example, a decision were made in 1974 and the heat recovery system were on-line in 1977, there would be a 3-year period during which the two-landfill system (Alternative 2) would be used (Alternative 5A). The slight decrease in unit cost ($5.50/ton) is attributable to the estimated 6% annual increase in waste handled over the period (1973-1977).

By 1977, a transfer station at Cooksville would be added (Alternative 5B). The purpose of this facility would be to increase the waste supplied to the heat recovery facility.

The operation of a combined heat recovery-transfer station-landfill system is shown in Alternative 5C. The tonnage handled (3578 tons/week) is the average for the period 1977 to 1992. The total system unit cost ($13.60/ton) suggests that the justification for the heat recovery system lies in the difference between $13.60/ton and $5.50/ton for the landfill system.

Tables 9 and 10, Chapter 1 show some typical resource recovery values. Items F and G, Table 10 suggest that the resource recovery facility could be competitive with the landfill system. There are two cautionary notes: (1) the $13.60/ton note is based upon the

McLean County 1973-1976

Dynamic Resource Recovery System Development

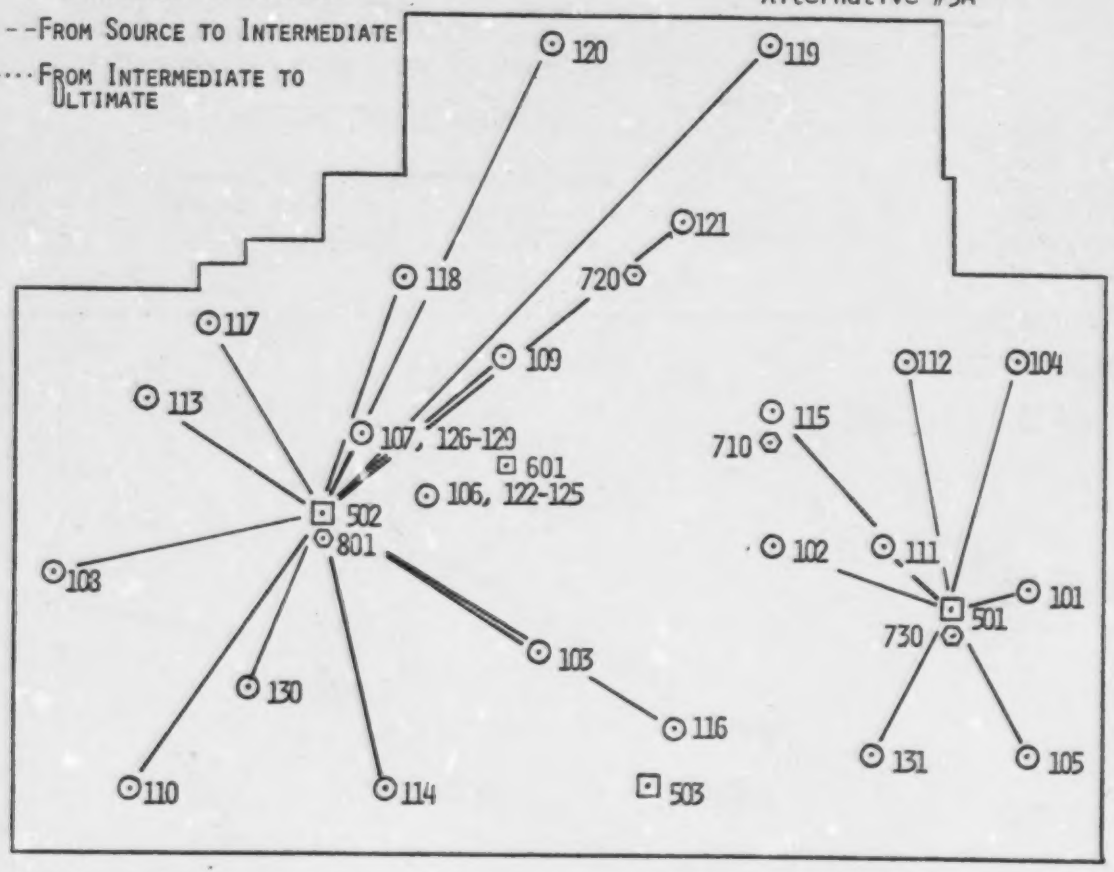
Alternative #5A

Key:

—— From Source to Ultimate

- - - From Source to Intermediate

····· From Intermediate to Ultimate



Sources

101 - Saybrook	113 - Danvers
102 - Ellsworth	114 - Heyworth
103 - Downs	115 - Cooksville
104 - Anchor	116 - LeRoy
105 - Belleflower	117 - Carlock
106 - Bloomington	118 - Hudson
107 - Normal	119 - Chenoa
108 - Stanford	120 - Gridley
109 - Towanda	121 - Lexington
110 - McLean	122 to 125 - Bloomington
111 - Arrowsmith	126 to 129 - Normal
112 - Colfax	130 - Waste Center #1
	131 - Waste Center #2

Intermediate Facilities

710 - Cooksville Transfer
720 - Lexington Transfer
730 - Bradd's Transfer
801 - Resource Recovery Plant

Ultimate Facilities

*501 - Bradd's Landfill
*502 - McLean County Landfill
*503 - LeRoy Landfill
601 - Towanda Landfill

*Used for Current Date.

General Haul Cost Assumptions

Packer Haul Cost	$4.36/Ton-Hr.
Transfer Haul Cost	$1.40/Ton-Hr.

General Cost Summary

Total Facility Annual Cost	$247,100
Total System Haul Cost	352,300
Total System Annual Cost	$599,400
Total System Annual Unit Cost	$5.50/Ton
Tonnage Handled	2097/Week

This alternative is the initial period of development for the resource recovery system. The transfer station and heat recovery incineration facility are under development and construction. This period allows an appropriate amount of lead time.

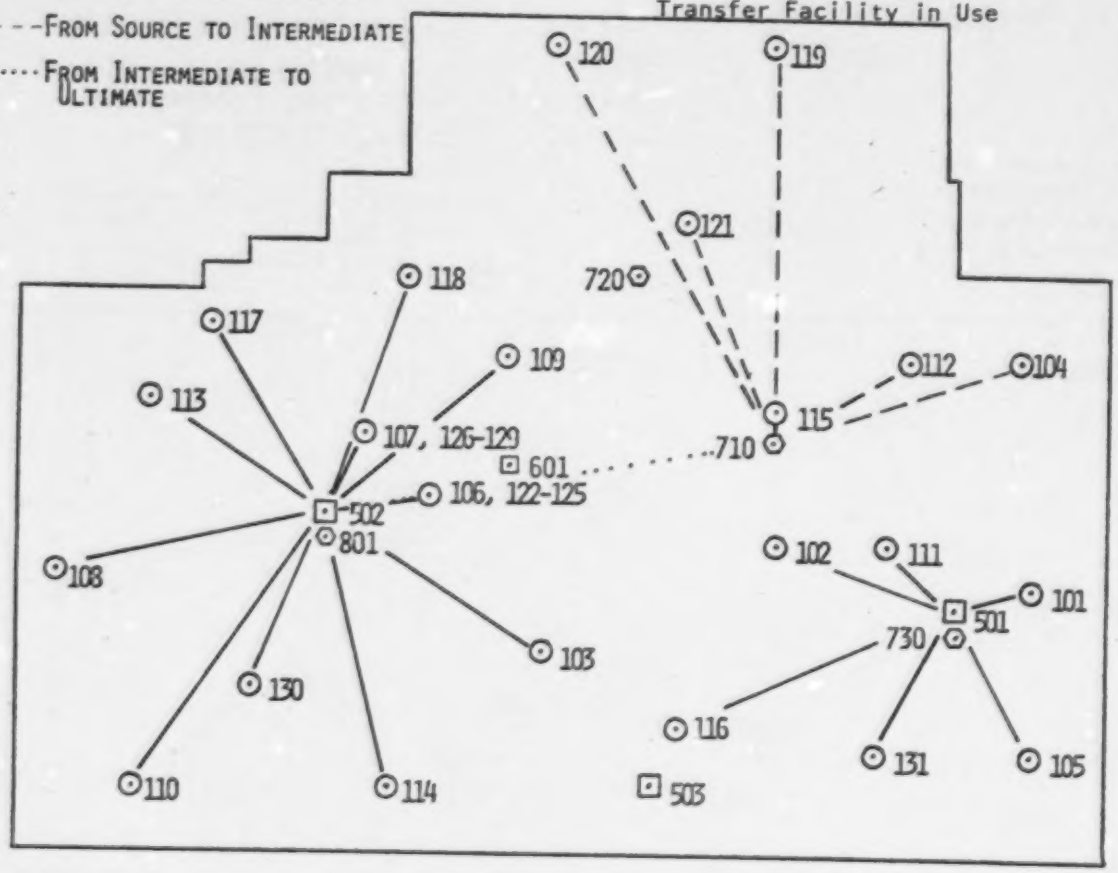
KEY:

—— FROM SOURCE TO ULTIMATE

- - - FROM SOURCE TO INTERMEDIATE

····· FROM INTERMEDIATE TO ULTIMATE

MCLEAN COUNTY 1976-1977
Dynamic Resource Recovery System
Alternative #5B
Transfer Facility in Use



SOURCES

101 - SAYBROOK
102 - ELLSWORTH
103 - DOWNS
104 - ANCHOR
105 - BELLEFLOWER
106 - BLOOMINGTON
107 - NORMAL
108 - STANFORD
109 - TOWANDA
110 - MCLEAN
111 - ARROWSMITH
112 - COLFAX
113 - DANVERS
114 - HEYWORTH
115 - COOKSVILLE
116 - LEROY
117 - CARLOCK
118 - HUDSON
119 - CHENOA
120 - GRIDLEY
121 - LEXINGTON
122 TO 125 - BLOOMINGTON
126 TO 129 - NORMAL
130 - WASTE CENTER #1
131 - WASTE CENTER #2

INTERMEDIATE FACILITIES

*710 - COOKSVILLE TRANSFER
720 - LEXINGTON TRANSFER
730 - BRADD'S TRANSFER
801 - Resource Recovery Plant

ULTIMATE FACILITIES

*501 - BRADD'S LANDFILL
*502 - MCLEAN COUNTY LANDFILL
503 - LEROY LANDFILL
601 - TOWANDA LANDFILL

*USED FOR CURRENT DATE.

General Haul Cost Assumptions

Parker Haul Cost $4.36/Ton-hour
Transfer Haul Cost $1.40/Ton-hour

General Cost Summary

Total Facility Annual Cost	$269,400
Total System Haul Cost	$398,700
Total System Annual Cost	$668,100
Total System Annual Unit Cost	$5.85/Ton
Tonnage Handled	2295

This alternative is the interim system for the development of the resource recovery program. The transfer station for the eastern portion of the county was completed and used for the 1976-1977 year and the incinerator will be on line in 1977.

McLean County 1978-1982

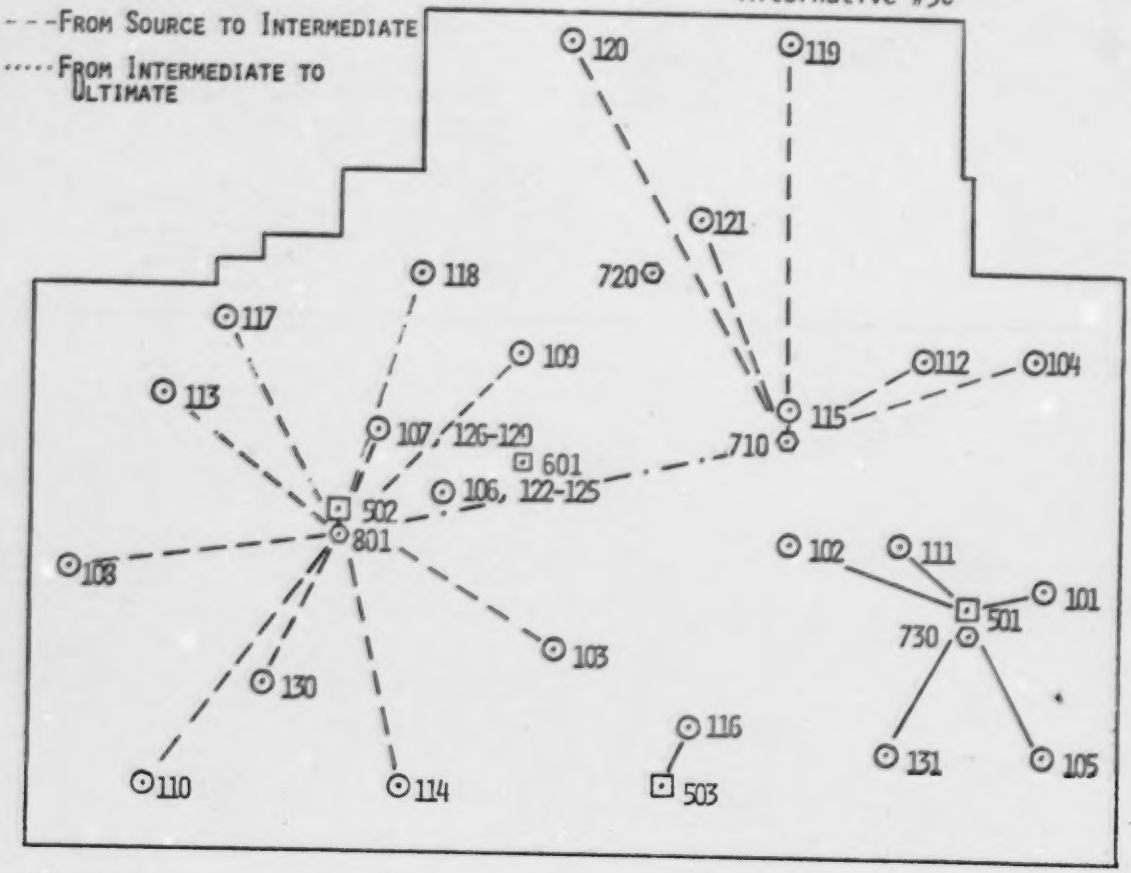
Dynamic Resource Recovery System
Alternative #5C

Key:

—— From Source to Ultimate

- - - From Source to Intermediate

····· From Intermediate to Ultimate



Sources

101 - Saybrook
102 - Ellsworth
103 - Downs
104 - Anchor
105 - Belleflower
106 - Bloomington
107 - Normal
108 - Stanford
109 - Towanda
110 - McLean
111 - Arrowsmith
112 - Colfax
113 - Danvers
114 - Heyworth
115 - Cooksville
116 - LeRoy
117 - Carlock
118 - Hudson
119 - Chenoa
120 - Gridley
121 - Lexington
122 to 125 - Bloomington
126 to 129 - Normal
130 - Waste Center #1
131 - Waste Center #2

Intermediate Facilities

*710 - Cooksville Transfer
720 - Lexington Transfer
730 - Bradd's Transfer
*801 - Resource Recovery Plant

Ultimate Facilities

501 - Bradd's Landfill
*502 - McLean County Landfill
*503 - LeRoy Landfill
601 - Towanda Landfill

*Used for Current Date.

General Haul Cost Assumptions

Packer Haul Cost	$4.36/Ton-Hr.
Transfer Haul Cost	$1.40/Ton-Hr.

General Cost Summary

Total Facility Annual Cost	$1,834,500
Total System Haul Cost	645,600
Total System Annual Cost	$2,480,000
Total System Unit Cost	$13.60/Ton
Tonnage Handled	3528/Ton-Week

The resource recovery system is in full operation and the completion of the small Bradd's Landfill will take place in 1982. The unit cost for this system is high, but a reasonable market value for the recovered resource could provide revenues to offset the operational expense.

Reproduced from best available copy.

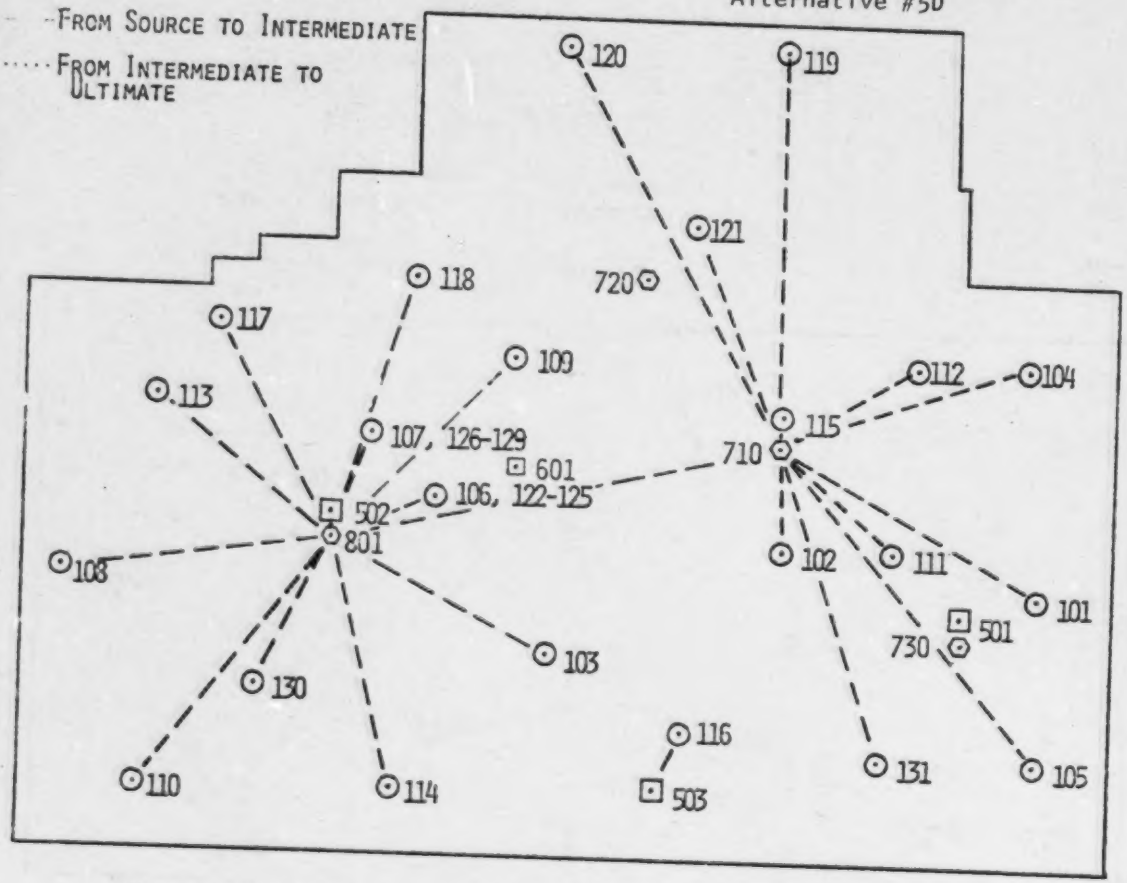
KEY:

——— FROM SOURCE TO ULTIMATE

– – – FROM SOURCE TO INTERMEDIATE

····· FROM INTERMEDIATE TO ULTIMATE

McLEAN COUNTY 1982-1992
Dynamic Resource Recovery System
Alternative #5D



SOURCES

101 - SAYBROOK
102 - ELLSWORTH
103 - DOWNS
104 - ANCHOR
105 - BELLEFLOWER
106 - BLOOMINGTON
107 - NORMAL
108 - STANFORD
109 - TOWANDA
110 - McLEAN
111 - ARROWSMITH
112 - COLFAX
113 - DANVERS
114 - HEYWORTH
115 - COOKSVILLE
116 - LeROY
117 - CARLOCK
118 - HUDSON
119 - CHENOA
120 - GRIDLEY
121 - LEXINGTON
122 TO 125 - BLOOMINGTON
126 TO 129 - NORMAL
130 - WASTE CENTER #1
131 - WASTE CENTER #2

INTERMEDIATE FACILITIES

710 - COOKSVILLE TRANSFER
720 - LEXINGTON TRANSFER
730 - BRADD'S TRANSFER
801 - Resource Recovery

ULTIMATE FACILITIES

501 - BRADD'S LANDFILL
*502 - McLEAN COUNTY LANDFILL
*503 - LeROY LANDFILL
601 - TOWANDA LANDFILL

*USED FOR CURRENT DATE.

General Haul Cost Assumption

Parker Haul Cost	$4.36/Ton-Hour
Transfer Haul Cost	$1.40/Ton-Hour

General Cost Summary

Total Facility Annual Cost	$1,865,945
Total System Haul Cost	645,600
Total System Annual Cost	$2,511,545
Total System Unit Cost	$13.45/Ton
Tonnage Handled	3591

Resource Recovery System with Only the McLean County and LeRoy Landfill in operation with the Processing Facility

average tonnage expected during the 1977-1992 period. At the present level of 1945 tons/week the cost would be about $25.00/ton; (2) the values given on Table 10 are based on theoretical studies and have not been proven in a large-scale, operating system. Such systems are under design and construction and the next five years will undoubtedly remove many of the uncertainties associated with system costs and markets for recovered materials.

Another problem related to the resource recovery alternative is the capital cost of facilities. The system will cost on the order of $2.5 - 4.0 million (depending on the process, capacity, and special features). This capital may come from private investors or from the sale of revenue bonds. In either case, there can be no capital investment without a long-term commitment to provide minimum quantities of waste at a specified gate fee.

Summary of Long-Term Alternatives

The long-term solution with the least risk and complexity is the sanitary landfill. One fill should be as close to Bloomington-Normal as possible. One or more smaller landfills serving the county may be justified because of high haul costs. There are opportunities for reducing the cost of marginal landfill operations. The total land requirement for the 17-year period is approximately 188 acres. Such land can be restored to agricultural production.

A resource recovery facility may be justified for the Bloomington-Normal area based upon the average tonnages expected during the 1977-1990 period. There would be a continuing need for a landfill to receive the residue from such a facility. If a decision is made in 1976 to build a resource recovery system, it would probably not be in operation until 1980. This could coincide with the completion and closing of the Mc Lean County landfill site.

Conclusion

An additional landfill site will be required in the Bloomington-Normal area by 1980. The size of the site will depend upon whether or not the resource recovery system is adopted. The decision on resource recovery should be made in 1976. Some immediate savings are indicated by optimizing haul distances and by closing or by modifying the operation of small, under utilized landfill sites.

Modification of Alternatives

These alternatives are intended for use by local officials and planners who must find the solution which best meets the desires and needs of the people. The costs given are based upon state and industry-wide averages. They can be adjusted by the planner if valid local cost factors are available. The Illinois Institute for Environmental Quality is prepared to assist the local planning effort.

APPENDIX A

MC LEAN COUNTY INFORMATION

		PAGE
1	Geological Information	A-1
2	Population Projections - Table A-1	A-2
3	Employment Projections - Table A-2	A-3
4	Total Solid Waste Quantities Per Source - Table A-3	A-8

GEOLOGICAL INFORMATION

MC LEAN COUNTY

Type of Bedrock: Mainly shale, and some permeable limestone and sandstone.

Drift Thickness: West half, southeast corner - over 200 ft., remainder over 50 ft.

Type of Drift Material: Till

Glacial Aquifers: Present

Sand and Gravel Aquifers: Extensive in southwest corner, scattered over rest of county.

Limestone Aquifers: Probably present.

Sandstone Aquifers: Probably present.

The bedrock in Mc Lean County is mainly shale with water-yielding sandstone and limestone. In the bedrock, there are two buried valleys, one to the northwest and one to the southwest. The glacial drift which filled these valleys in is over 50 ft. deep everywhere, and in some places, it is over 200 ft. deep. Loess of 4 to 8 ft. covers the till drift material. Sand and gravel aquifers are scattered over most of the county with an extensive number located in the southwest corner. Only in the north part do limestone aquifers occur, but sandstone aquifers are found throughout the county.

The potential for contamination of the bedrock aquifers is low except for a small area in the north central area, which has a thinner layer of drift than the rest of the area. Along the Mackinaw and the Kickapoo Rivers, the potential for contamination of the unconsolidated aquifer is high, but other than these areas, the level is low. Most of area within the county appears to be suitable for landfilling operations from a geological standpoint.

Table A-1

PROJECTED POPULATION FOR MC LEAN COUNTY

LOCATION	1970*	1975	1980	1985	1990	1995	2000
Anchor	200	220	230	230	240	250	250
Arrowsmith	305	305	350	360	390	400	410
Belleflower	400	500	560	620	680	760	810
Bloomington	39,992	44,500	48,500	51,400	54,000	57,100	59,800
Carlock	373	390	400	410	420	440	450
Chenoa	1,860	2,070	2,230	2,390	2.530	2,700	2,850
Colfax	935	1,060	1,130	1,190	1,240	1,300	1,360
Cooksville	241	300	340	370	410	450	490
Danvers	854	970	1,030	1,090	1,150	1,210	1,270
Downs	651	770	870	970	1,070	1,180	1,280
Ellsworth	259	270	280	290	300	310	320
Gridley	1,007	1,160	1,250	1,340	1,420	1,520	1,610
Heyworth	1,441	1,650	1,790	1,930	2,060	2,220	2,360
Hudson	802	900	1,030	1,150	1,280	1,420	1,550
Le Roy	2,435	2,780	3,010	3,230	3,440	3,690	3,910
Lexington	1,615	1,730	1,850	1,970	2,080	2,210	2,320
Mc Lean	820	940	1,010	1,080	1,140	1,210	1,270
Normal	26,396	29,700	34,400	39,100	43,800	49,000	54,100
Saybrook	814	940	990	1,030	1,070	1,110	1,150
Stanford	657	700	760	810	870	930	980
Towanda	578	700	760	820	880	940	1,000
SUB TOTAL	82,635	93,800	102,000	112,000	120,667	130,000	139,000
UNINCORPORATED	21,754	23,400	24,200	24,800	25,300	25,900	26,400
COUNTY TOTAL**	104,389	117,278	127,174	136,879	145,967	156,555	166,110

* Census Data Report PC(V1)-15 January 1971

** Summations Performed Prior To Rounding Off

Table A-2

PROJECTED EMPLOYMENT FOR BLOOMINGTON

FOR EMPLOYMENT WITHIN SIC LISTED IN THE INDUSTRIAL GENERATION FACTOR TABLE

SIC	1971	1975	1980	1985	1990	1995	2000
201	70	70	70	70	70	70	70
202	55	66	65	67	66	72	76
204	0	150	150	160	160	180	190
205	69	59	45	34	26	20	16
207	500	500	500	500	500	500	500
208	40	20	10	6	2	1	0
209	119	119	119	119	119	119	119
233	3	2	1	1	0	0	0
2432	5	9	11	15	16	20	22
251	3	2	2	2	2	2	2
259	15	22	26	30	33	38	43
265	40	56	82	100	120	140	170
271	274	274	274	274	274	274	274
273	170	314	408	496	571	671	772
275	158	148	154	157	168	176	195
278	30	31	30	33	34	37	40
283	4	1	0	0	0	0	0
3272	3	0	0	0	0	0	0
327	47	38	27	20	13	10	7
329	0	86	49	30	17	10	7
336	2	0	0	0	0	0	0
334	9	16	19	22	24	28	32
346	56	54	48	45	41	40	39
348	4	0	0	0	0	0	0
352	150	158	173	180	188	203	225
354	25	30	43	50	60	70	80
356	3	0	0	0	0	0	0
357	22	0	0	0	0	0	0

Table A-2 (Continued)

PROJECTED EMPLOYMENT FOR BLOOMINGTON

FOR EMPLOYMENT WITHIN SIC LISTED IN THE INDUSTRIAL GENERATION FACTOR TABLE (continued)

SIC	1971	1975	1980	1985	1990	1995	2000
358	1500	2470	2750	3020	3220	3630	4010
359	25	33	36	40	45	51	58
362	1100	1020	930	870	810	800	790
367	50	54	41	32	24	19	16
371	200	330	460	570	670	800	920
374	4	3	3	3	3	2	2
384	0	73	61	52	45	41	37
399	16	14	8	3	1	0	0
			CHENOA				
201	3	3	3	3	3	3	3
204	4	2	0	0	0	0	0
243	2	0	0	0	0	0	0
275	3	2	2	2	2	2	2
345	5	7	9	13	14	19	22
346	13	14	15	16	16	17	18
359	79	81	78	75	80	84	88
			COLFAX				
204	20	20	20	20	20	20	20
327	3	26	38	45	55	68	76
352	3	5	5	6	6	6	7
382	16	16	16	16	16	16	16
			DOWNS				
204	0	10	13	15	17	20	23
287	3	5	7	8	10	12	14

Table A-2 (Continued)

PROJECTED EMPLOYMENT FOR DOWNS

FOR EMPLOYMENT WITHIN SIC LISTED IN THE INDUSTRIAL GENERATION FACTOR TABLE

SIC	1971	1975	1980	1985	1990	1995	2000
204	0	10	13	15	17	20	23
287	3	5	7	8	10	12	14
				GRIDLEY			
201	13	6	4	1	0	0	0
2022	3	0	0	0	0	0	0
275	3	2	2	2	2	2	2
352	80	100	130	150	180	210	240
359	5	4	4	3	3	3	3
				HEYWORTH			
204	2	1	1	1	1	1	1
287	0	3	3	3	3	3	3
327	2	2	2	2	2	2	2
				LE ROY			
243	15	15	15	15	15	15	15
271	4	1	0	0	0	0	0
				LEXINGTON			
399	15	2	0	0	0	0	0

Table A-2 (Continued)

PROJECTED EMPLOYMENT FOR MCLEAN

FOR EMPLOYMENT WITHIN SIC LISTED IN THE INDUSTRIAL GENERATION FACTOR TABLE

SIC	1971	1975	1980	1985	1990	1995	2000
244	15	5	1	0	0	0	0
352	7	7	7	7	7	7	7
NORMAL							
275	15	21	27	32	37	43	49
278	60	79	100	140	170	210	240
301	225	225	225	225	225	225	225
327	32	32	35	35	35	35	35
SAYBROOK							
201	2	2	0	0	0	0	0
275	1	1	1	2	2	2	2
TOWANDA							
201	2	2	1	0	0	0	0
204	0	4	4	3	3	3	3
DANVERS							
201	15	15	15	15	15	15	15
CARLOCK							
243	5	5	5	5	5	5	

Table A-2 (Continued)

PROJECTED EMPLOYMENT FOR HUDSON

FOR EMPLOYMENT WITHIN SIC LISTED IN THE INDUSTRIAL GENERATION FACTOR TABLE

SIC	1971	1975	1980	1985	1990	1995	2000
209	20	20	20	20	20	20	20

Table A-3
Solid Waste Quantity by Source

SOURCE NAME	SOURCE ID NO.	1973 VALUES QUANTITY Tons/Week	1990 VALUE QUANTITY Tons/Week
Saybrook	101	21.	40.
Ellsworth	102	13.	23.
Downs	103	29.	63.
Anchor	104	16.	30.
Belleflower	105	15.	31.
Bloomington SW	106	182.	325.
Normal North	107	97.	248.
Stanford	108	26.	37.
Towanda	109	24.	51.
Mc Lean	110	28.	55.
Arrowsmith	111	14.	26.
Colfax	112	35.	82.
Danvers	113	26.	50.
Heyworth	114	34.	74.
Cooksville	115	13.	25.
Le Roy	116	54.	112.
Carlock	117	20.	37.
Hudson	118	22.	47.
Chenoa	119	51.	104.
Gridley	120	41.	59.
Lexington	121	37.	72.
Bloomington SE	122	183.	325.
Bloomington WC	123	183.	325.
Bloomington EC	124	183.	325.
Bloomington N.	125	183.	325.
Normal West	126	97.	248.
Normal Central	127	97.	248.
Normal East	128	97.	248.
Normal South	129	97.	248.
Waste Center 1	130	19.	38.
Waste Center 2	131	11.	22.
County Total		1948	3943

APPENDIX B

	Pages
1. Method for calculating municipal and industrial collection rates.	B-1
2. Industrial waste generation factors. Table B-1	B-3
3. Haul Cost Factor with assumptions. Table B-2	B-6
4. Cost Functions: Sanitary Landfill. Figure B-1	B-9
5. Basic Landfill Cost Assumptions For 50, 100, 250, 500, 1000, 2000, and 5000 tons/week. Tables B-3 to B-9	B-10
6. Cost Functions: Intermediate Processing Facilities. Figure B-2	B-18
7. Equations for Facility Cost Functions.	B-19
8. Resource Recovery Facility Description.	B-21
9. Resource Recovery Capital and Annual Cost. Table B-10	B-22

Municipal Generation Rates

The technique selected for estimating present generation rates was developed by Roy F. Weston, Inc. The technique involved the calculation of a generation rate factor which was then multiplied by the population to obtain the generation rate per week for a given geographic area. The generation factor is a function of the population density as shown in the following equations:

$$U = 1.54 \text{ Log } D - 0.68$$

$$V = U \times 7 \text{ day/week} \times 1 \text{ ton/2000 lbs.}$$

$$W = V \times \text{Population within the given area}$$

where: U = per capita waste generation rate in lbs/capita /day

D = population density in person/square miles

V = per capita waste generation rate in tons/capita/week

W = ton per week of waste generated within given area

This relationship is valid in the population density range of 500 - 12,000 persons/square mile. Below the lower limit of the range, the generation factor used is 3.4 lbs/capita/day; above the upper limit, the factor used is 5.6 lbs/capita/day.

Industrial Generation Rate

During the past few years, the Office of Solid Waste Management Programs has funded a number of industrial solid waste surveys to develop solid waste generation factors. A summary of these factors was used to develop industrial solid waste loads by SIC number. The following equation demonstrates the use of the generation factors.

$$I = G.F. \times \text{No. of Employees}$$

$$J = I \div 52$$

where I = yearly production rate in tons/year

G. F = generation factor in tons/employee/year

J = weekly production rate in tons/week

These relationships are used to estimate probable industrial waste loads, but the yearly employment fluctuation, and generation factors make adjustment necessary for specific locations and plants.

TABLE B-1

Industrial Solid Waste Generation Factors [8]

SIC No.	Name	Generation Factor (tons/employee/year)
201	Meat Products	14.1
2021	Creamery butter	33.0
2022	Cheese, Natural and Processed	169.1
202 (R)[1]	Dairy Products	2.2
203	Canned and Preserved Fruits, Vegetables and Sea Foods	5.4
204	Grain Mill Products	6.2
205	Bakery Products	1.2
206	Sugar	17.2
207	Confectionery and Related Products	3.3
208	Beverages	11.0
209	Miscellaneous Food Preparations and Kindred Products	0.8
211	Cigarettes	1.5
212	Cigars	3.1
213	Tobacco (Chewing and Smoking) and Snuff	0.2
214	Tobacco Stemming and Redrying	4.4
221	Broad Woven Fabric Mills, Cotton	0.4
222	Broad Woven Fabric Mills, Man-made Fiber and Silk	0.7
223	Broad Woven Fabric Mills	0.1
224	Narrow Fabrics and Other Small-wares Mills: Cotton, Wool, Silk and Man-made Fiber	1.2
225	Knitting Mills	1.3
226	Dyeing and Finishing Textiles, Except Wood Fabrics and Knit Goods	2.4
227	Floor Covering Mills	0.2
228	Yarn and Thread Mills	0.7
229	Miscellaneous Textile Goods	4.5
231	Men's, Youths', and Boys' Suits, Coats and Overcoats	0.3
232	Men's, Youths', and Boys' Furnishings, Work Clothing, and Allied Garments	0.3
233	Women's, Misses', and Juniors' Outerwear	0.9
234	Women's, Misses', Children's and Infants' Under Garments	0.4
235	Hats, Caps, and Millinery	0.2
236	Girls', Children's, and Infants' Outerwear	0.9
237	Fur Goods	0.5
238	Miscellaneous Apparel and Accessories	0.4
239	Miscellaneous-Fabricated Textile Products	0.4
241	Logging Camps and Logging Contractors	30.0
2421	Sawmills and planing mills, general	420.0
242 (R)[1]	Sawmills and planing mills	38.7
2432	Veneer and plywood	232.0
243 (R)[1]	Millwork, Veneer, Plywood, and Prefabricated Structural Wood Products	21.7
244	Wooden Containers	16.0
249	Miscellaneous Wood Products	43.0
251	Household Furniture	1.8
252	Office Furniture	2.6
253	Public Building and Related Furniture	1.8
254	Partitions, Shelving, Lockers, and Office and Store Fixtures	3.6
259	Miscellaneous Furniture and Fixtures	1.5
261	Pulp Mills	31.5
262	Paper Mills, Except Building Paper Mills	11.7
263	Paperboard Mills	11.5
264	Converted Paper and Paperboard Products, Except Containers and Boxes	4.0
265	Paperboard Containers and Boxes	12.6
266	Building Paper and Building Board Mills	103.0
271	Newspapers: Publishing, Publishing and Printing	1.1
272	Periodicals: Publishing, Publishing and Printing	0.1
273	Books	0.8
274	Miscellaneous Publishing	0.1
275	Commercial Printing	1.1
276	Manifold Business Forms	4.4
277	Greeting Card Publishing	1.2
278	Blankbooks, Loose Leaf Binders, and Bookbinding and Related Work	2.6
279	Service Industries for Printing Trade	1.4
2819	Industrial Inorganic Chemicals, not Elsewhere Classified	109.0
281 (R)[1]	Industrial Inorganic and Organic Chemicals	18.8
282	Plastics Materials and Synthetic Resins, Synthetic Rubber, Synthetic and Other Man-Made Fibers, Except Glass	16.2

TABLE B-1

Industrial Waste Generation Factors (Continued)

SIC No.	Name	Generation Factor (tons/employee/year)
283	Drugs	3.4
284	Soap, Detergents, and Cleaning Preparations, Perfumes, Cosmetics, and Other Toilet Preparations	3.3
285	Paints, Varnishes, Lacquers, Enamels, and Allied Products	6.2
286	Gum and Wood Chemicals	0.1
287	Agricultural Chemicals	13.5
2891	Adhesives and gelatin	39.4
289 (R)[1]	Miscellaneous Chemical Products	1.2
291	Petroleum Refining	30.6
295	Paving and Roofing Materials	0.9
299	Miscellaneous Products of Petroleum and Coal	9.3
301	Tires and Inner Tubes	3.7
302	Rubber Footwear	2.1
303	Reclaimed Rubber	2.4
306	Fabricated Rubber Products, Not Classified Elsewhere	2.5
307	Miscellaneous Plastics Products	1.3
311	Leather Tanning and Finishing	2.3
312	Industrial Leather Belting and Packing	0.8
313	Boot and Shoe Cut Stock and Findings	1.8
314	Footwear, Except Rubber	0.4
315	Leather Gloves and Mittens	1.3
316	Luggage	7.0
317	Handbags and Other Personal Leather Goods	0.4
319	Leather Goods, Not Elsewhere Classified	0.5
321	Flat Glass	2.5
322	Glass and Glassware, Pressed or Blown	1.4
323	Glass Products, Made of Purchased Glass	1.8
324	Cement, Hydraulic	8.8
325	Structural Clay Products	1.7
326	Pottery and Related Products	3.6
3272	Concrete products, except block and brick	154.0
327 (R)[1]	Concrete, Gypsum, and Plaster Products	15.0
328	Cut Stone and Stone Products	4.2
329	Abrasive, Asbestos, and Miscellaneous Nonmetallic Mineral Products	5.2
3312	Blast Furnaces (including coke ovens), Steel Works, and Rolling Mills	130.0
331 (R)[1]	Blast furnaces, Steel Works, and Rolling and Finishing Mills	3.4
3321	Gray Iron foundries	100.0
332 (R)[1]	Iron and Steel Foundries	20.0
3334	Primary production of aluminum	58.0
333 (R)[1]	Primary Smelting and Refining of Nonferrous Metals	2.5
334	Secondary Smelting and Refining of Nonferrous Metals	103.0
335	Rolling, Drawing and Extruding of Nonferrous Metals	5.3
336	Nonferrous Foundries	2.7
339	Miscellaneous Primary Metal Products	2.0
341	Metal Cans	11.2
342	Cutlery, Hand Tools, and General Hardware	2.8
343	Heating Apparatus (Except Electric) and Plumbing Fixtures	7.3
344	Fabricated Structural Metal Products	2.8
345	Screw Machine Products, and Bolts, Nuts, Screws, Rivets and Washers	2.9
346	Metal Stampings	6.2
347	Coating, Engraving and Allied Services	1.5
348	Miscellaneous Fabricated Wire Products	3.1
3491	Metal Shipping Barrels, Drums, Kegs and Nails	13.7
349	Miscellaneous Fabricated Metal Products	1.4
351	Engines and Turbines	1.5
352	Farm Machinery and Equipment	0.9
353	Construction, Mining, and Materials Handling Machinery and Equipment	2.2
354	Metalworking Machinery and Equipment	2.9
355	Special Industry Machinery, Except Metalworking Machinery	0.7
356	General Industrial Machinery and Equipment	1.3
357	Office, Computing, and Accounting Machines	0.8
358	Service Industry Machines	1.5
359	Miscellaneous Machinery, Except Electrical	1.4
361	Electric Transmission and Distribution Equipment	0.8
362	Electrical Industrial Apparatus	0.7
363	Household Appliances	2.4
364	Electric Lighting and Wiring Equipment	2.2
365	Radio and Television Receiving Sets, Except Communication Types	0.8

TABLE B-1

Industrial Waste Generation Factors (Continued)

SIC No.	Name	Generation Factor (tons/employee/year)
366	Communication Equipment	1.9
367	Electronic Components and Accessories	1.0
369	Miscellaneous Electrical Machinery Equipment, and Supplies	2.8
371	Motor Vehicles and Motor Vehicle Equipment	2.4
372	Aircraft and Parts	1.2
3731	Ship Building and Repairing	37.0
3732	Boat Building and Repairing	4.1
374	Railroad Equipment	6.2
375	Motorcycles, Bicycles, and Parts	2.9
379	Miscellaneous Transportation Equipment	1.7
381	Engineering, Laboratory, and Scientific and Research Instruments and Associated Equipment	1.1
382	Instruments for Measuring, Controlling, and Indicating Physical Characteristics	0.4
383	Optical Instruments and Lenses	0.5
384	Surgical, Medical, and Dental Instruments and Supplies	2.3
385	Ophthalmic Goods	2.6
386	Photographic Equipment and Supplies	0.4
387	Watches, Clocks, Clockwork Operated Devices, and Parts	0.6
391	Jewelry, Silverware, and Plated Ware	0.8
393	Musical Instruments	0.6
394	Toys, Amusement, Sporting and Athletic Goods	1.7
395	Pens, Pencils, and Other Office and Artists' Materials	0.5
396	Costume Jewelry, Costume Novelties, Buttons, and Miscellaneous Notions, Except Precious Metal	0.3
399	Miscellaneous Manufacturing Industries	2.0

1) Includes the waste in the remainder of the 4-digit codes under this 3-digit code.

TABLE B-2

HAUL COST FACTORS

Type of Truck	Capacity, yd^3	Compacted Density lbs/yd^3	Cost of Truck($)	Life of Truck(yr)	Daily Operating Cost ($)	No. in Crew		Wages, $/hr.(3)				Work-Day (Hrs.)	Work-Week (Days)	Haul Cost($/ton-hr.)	
								Chicago		Downstate					
						Driver	Laborer	Driver	Laborer	Driver	Laborer			Chicago	Downstate
Rear Loading Compactor	16	500	17,175	5	40	1	1	7.19	6.56	5.70	5.10	8	5	5.10	4.36
Rear Loading Compactor (Municipal	25	500	20,772	5	35	1	2	7.19	6.56	5.70	5.10	8	5	4.28	3.66
Rear Loading Compactor (Private)	25	800	30,444	5	35	1	2	7.19	6.56	5.70	5.10	8	5	2.76	2.32
Front Loading Compactor	30	800	42,875	5	40	1	0	7.19	-	5.70	-	8	5	1.35	1.23
Tilt Frame & 13 Containers	42	500	42,325(1)	5	35	1	0	7.19	-	5.70	-	8	5	1.98	1.75
Tractor & 2 Transfer Trailers	75	500	75,800(2)	5	52	1	0	7.19	-	5.70	-	8	6	1.10	1.00*

(1) Includes the cost of the 13 containers.
(2) Includes the cost of the 2 transfer trailers.
(3) Includes fringe benefits.
* $1.40/Ton-Hr. For Vehicles operated 6 hours per day

ASSUMPTIONS FOR HAUL COST CALCULATIONS

Chicago Area

Assumptions:

1. 45% residential, 30% industrial, & 25% commercial solid waste.
2. 50% private and 50% public collection in the residential sector.
3. Only private collection in the industrial and commercial sectors.
4. 24 yd^3 compactor trucks used for residential collection.
5. Tilt-frame trucks used for industrial collection.
6. 30 yd^3 front loading compactor trucks used for commercial collection.
7. 5 loads/day by tilt-frame trucks.
8. 3 loads/day by front loading compactor trucks.

Haul Costs:

1. From collection route to intermediate facility or disposal site, collection vehicles operate 8 hours per day.
2. From intermediate facility to disposal site, vehicles operate 8 hours per day - $1.10/ton-hr.

Downstate

Assumptions:

1. 75% residential, 15% industrial, and 10% commercial solid waste.
2. 50% private and 50% public collection in the residential sector.
3. Only private collection in the industrial and commercial sectors.
4. 25 yd^3 compactor trucks used for residential collection.

5. Tilt-frame trucks used for industrial collection.

6. 30 yd^3 front loading compactor trucks used for commercial collection.

7. 5 loads/day by tilt-frame trucks.

8. 3 loads/day by front loading compactor trucks.

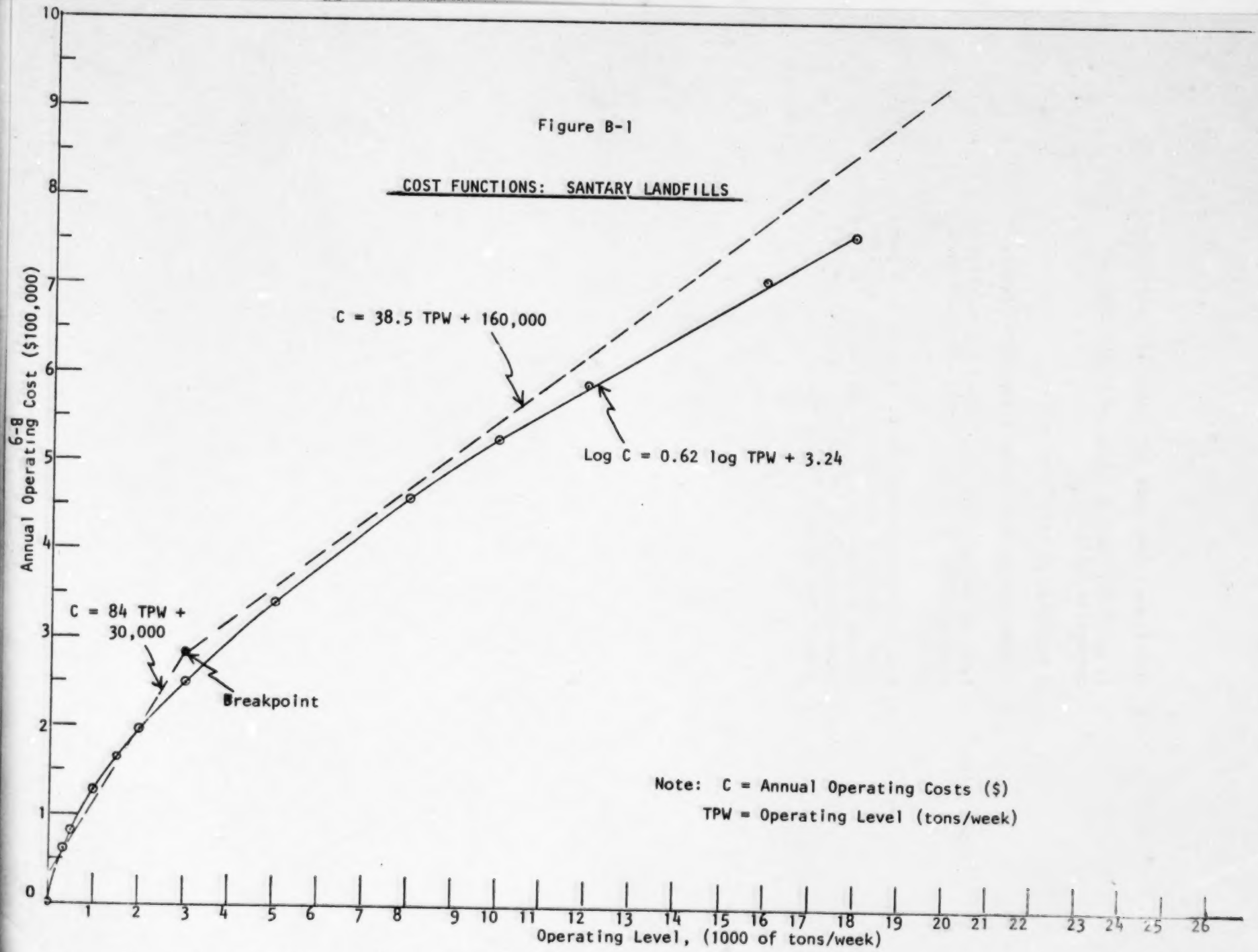
Haul Costs:

1. From collection route to intermediate facility or disposal site, collection trucks operate 8 hours per day.

2. From intermediate facility to disposal site where total loads are less than 150 tons/day, vehicles operate 6 hours per day - $1.40/ton-hr. For total loads greater than 150 ton/day, vehicles operate 8 hours per day - $1.00/ton-hr.

Figure B-1

COST FUNCTIONS: SANTARY LANDFILLS


C = 38.5 TPW + 160,000
Log C = 0.62 log TPW + 3.24
C = 84 TPW + 30,000
Breakpoint
Note: C = Annual Operating Costs ($)
TPW = Operating Level (tons/week)
Annual Operating Cost ($100,000)
Operating Level, (1000 of tons/week)
0 1 2 3 4 5 6 7 8 9 10
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26

BASIC LANDFILL COST ASSUMPTIONS

TABLE B-3
ASSUMING EXCAVATION DONE BY RENTED OR LEASED UNIT

50 TPW

EQUIPMENT TABLE A

	CAPITAL COST		OWNING		O&M
Farm Tractor & Loader or Blade	$15,000	@ 22%	$3,600	@24%	$3,300
Fuel	500		119		50
	$15,500		$3,719		$3,350

PERSONNEL COST-TABLE B

Supervisor & Operator @ $11.50/Hr. and fringe for 2 days a week - $184./Wk.
$9568./Per Year

FACILITY COST ESTIMATE- TABLE C

		Yr.	CC	@%	AC
1.	Design	25	$ 9,000	8	720
2.	Preparation	25	12,000	8	840
3.	Building Facilities	25	1,000	8	80
4.	Equipment	varies	$15,500		3,719
	Sub-Total		$37,500		
5.	Supervision & Inspection	25	2,510	8	201
	Sub-Total		$40,010		
6.	Contingency 10%	25	4,001	8	320
	Sub-Total		$44,011		
7.	Legal 3%	25	1,320		106
	Sub-Total		$45,331		
8.	Bond Discount 3%	25	1,360		109
	TOTAL CAPITAL COST		$46,691		6095.

ANNUAL COST	
A. Sum of 1-8	$6,095
B. Equipment	3,350
Facility CC-3 50% of	500
Miscellaneous 3% of CC-2	360
C. Salaries	9,568
Overhead	
Total Annual Cost	$19,873
Annual Cost/Ton	$ 7.64
@ 52 Weeks	
@ 50 TPW	

O&M- OPERATION AND MAINTENANCE
Yr.- NUMBER OF YEARS AMORTIZED OVER
CC - CAPITAL COST
@% - % CAPITAL RECOVERY PER YEAR
AC - ANNUAL CAPITAL RECOVERY VALUE

TABLE B-4

BASIC LANDFILL COST FUNCTION ASSUMPTIONS

100 TPW

EQUIPMENT TABLE A

	CAPITAL COST	OWNING		O&M	
Tractor & Loader or Blade	$15,000	24%	$3,600	30%	$4,500
Fuel	500		119		50
	$15,500		$3,719		$4,550

PERSONNEL COST TABLE B

Supervisor and Operator @ $11.50/Hr. include Fringe for 4 days a week - $19,136

FACILITY COST ESTIMATE TABLE C

		YR	CC	@%	AC
1.	Design	25	$10,000	8	$ 800
2.	Preparation	25	13,000	8	1,040
3.	Building Facilities	25	1,000	8	80
4.	Equipment	varies	15,500		3,719
	Sub-Total		$39,500		
5.	Supervision & Inspection	25	3,020		242
	Sub-Total		$42,520		
6.	Contingency - 10%	25	4,252		340
	Sub-Total		$46,772		
7.	Legal 3%	25	1,403		112
	Sub-Total		$48,175		
8.	Bond Discount 3%	25	1,445		116
	TOTAL CAPITAL COST		$49,620		$6,449

ANNUAL COST	
A. Sum of 1-8	$ 6,449
B. Equipment	$ 4,550
Facility 50% of CC-3	500
Miscellaneous 3% of CC-2	390
C. Salaries	$19,136
Total Annual Cost	$30,975
Annual Cost/Ton @ 52 Weeks @ 100 Tons	$5.96

O&M- OPERTION AND MAINTENANCE
Yr.- NUMBER OF YEARS AMORTIZED OVER
CC - CAPITAL COST
@% - % CAPITAL RECOVERY PER YEAR
AC - ANNUAL CAPITAL RECOVERY VALUE

TABLE B-5

BASIC LANDFILL COST ASSUMPTIONS

250 TPW

EQUIPMENT TABLE A

	YEAR	CAPITAL COST	%	OWNING	%	O & M
Crawler	5	$36,000	24	$8,546	22	$8,000
Fuel	5	500	24	119		50
		$36,500		$8,665		$8,050

PERSONNEL COST TABLE B

		ANNUAL
1 Laborer $4/Hr.- 2080	Fringes	$8,320
1 Operator & Supervisor $11.50/Hr - 2080	"	24,000
		$32,320

FACILITY COST ESTIMATE TABLE C

		Yr.	CC	@%	AC
1.	Design	25	$11,000	8	$ 880
2.	Preparation	25	14,000	8	1,120
3.	Building Facilities	25	1,000	8	80
4.	Equipment	varies	36,500		8,665
	Sub-Total		$62,500		
5.	Supervision & Inspection 2% of 4 10% of 1-3	25	3,330	8	266
	Sub-Total		$65,830		
6.	Contingency 10%	25	6,583	8	527
	Sub-Total		$72,413		
7.	Legal 3%	25	2,172	8	174
	Sub-Total		$74,585		
8.	Bond 3%	25	2,238	8	179
	TOTAL CAPITAL COST		$76,823		$11,891

ANNUAL COST

A.	Lines 1-8	$11,891
B.	Equipment	8,050
	Facility 50% of CC-3	500
	Miscellaneous 3% of CC-2	420
C.	Salaries	$32,320
	Total Annual Cost	$53,181
	Annual Cost/Unit	$ 4.13/Ton

O&M- OPERATION AND MANTENANCE
Yr.- NUMBER OF YEARS AMORTIZED OVER
CC - CAPITAL COST
@% - % CAPITAL RECOVERY PER YEAR
AC - ANNUAL CAPITAL RECOVERY VALUE

TABLE B-6

BASIC LANDFILL COST ASSUMPTIONS

500 TPW

EQUIPMENT - TABLE A

	YEAR	CAPITAL COST	%	OWNING	%	O&M
Crawler 195Hp	5	$58,000	24	$13,779	24	$13,800
Fuel	5	800		190		100
Scales	10	$ 7,500	14	1,019	8	600
		$66,300		$14,988		$14,500

LABOR TABLE B

Supervisor Scale Man $4/Hr. $5/Hr.	$11,000
Operator @ $11.50 for 2080 Hr.	24,000
Laborer $4.00/Hr. for 2080 Hr.	8,320
	$4 ,320

FACILITY COST ESTIMATE TABLE C

		YR.	CC	@%	AC
1.	Design	25	$15,000	8	$ 1,173
2.	Preparation	25	20,000	8	1,565
3.	Building Facilities	25	8,000	8	640
4.	Equipment	Varies	66,300		14,988
	Sub-Total		$109,300		
5.	Supervision & Inspection	25	5,626	8	450
	Sub-Total		$114,926		
6.	Contingency 10%	25	11,493	8	919
	Sub-Total		$126,419		
7.	Legal 3%	25	3,793	8	303
	Sub-Total		$130,212		
8.	Bond Discount 3%	25	3,906	8	312
	TOTAL CAPITAL COST		$134,118		$20,350

ANNUAL COST

A.	Line 1-8	$20,350
B.	Equipment	14,500
	Facility ≈50% of CC-3	3,500
	Miscellaneous 3% of CC-2	600
C.	Salaries	43.320
	Total Annual Cost	82,370
	Annual Unit Cost	$3.16/Ton

O&M- OPERTION AND MAINTENANCE
Yr.- NUMBER OF YEARS AMORTIZED OVER
CC - CAPITAL COST
@% - % CAPITAL RECOVERY PER YEAR
AC - ANNUAL CAPITAL RECOVERY VALUE

TABLE B-7

BASIC LANDFILL COST ASSUMPTIONS
1000 TPW

EQUIPMENT - TABLE A

	YR.	CC	%	OWNING	%	OPERATION & MAINTENANCE
1 115Hp Crawler	5	$ 36,000	24	$ 8,546	22	$ 8,000
1 170Hp Crawler	5	52,000	24	12,345	22	12,000
1 Fuel Port	5	3,000	24	712	7	200
Scales	10	10,000	14	1,359	10	1,000
		$101,000		$22,962		$21,200

PERSONNEL - TABLE B

Super & Scalemen	1	@ 2080 Hr. @ $8.17/Hr.	$17,000
Equip. Oper. 1.5	1.5	$24,000/Year	36,000
Labor	2		16,640
			$69,640

FACILITY COST ESTIMATE TABLE C

		YR.	CC	@%	A.C.
1.	Design	25	$ 17,500	8	$1,369
2.	Preparation	25	25,000	8	1,956
3.	Building Facilities	25	8,000	8	640
4.	Equipment	Varies	101,000	-	22,962
	Sub-Total		$151,500		
5.	Supervision & Inspection	25	7,070	8	566
	Sub-Total		$158,570		
6.	Contingency 10%	25	15,857	8	1,269
	Sub-Total		$174,427		
7.	Legal 3%	25	5,233	8	418
	Sub-Total		$179,660		
8.	Bond Discount 3%	25	5,390	8	431
	TOTAL CAPITAL COST		$185,050		$29,611

ANNUAL COST	
A. Line 1-8	$29,611
B. Equipment	21,200
Facility 50% of CC-3	4,000
Miscellaneous 3% of CC-2	750
	$55,561
C. Salaries	69,640
Total Annual	$125,201
Annual Unit Cost at 962 T/W at 52 W/Yr.	$2.50/Ton

O&M- OPERATION AND MAINTENANCE
Yr,- NUMBER OF YEARS AMORTIZED OVER
CC - CAPITAL COST
@% - % CAPITAL RECOVERY PER YEAR
AC - ANNUAL CAPITAL RECOVERY VALUE

TABLE B-8

BASIC LANDFILL COST ASSUMPTIONS

2000 TPW

EQUIPMENT TABLE A

	YR.	CAPITAL COST	%	OWNING	%	O&M
Crawler 195 Hp.	5	$ 58,000	24	$13,770	24	$13,800
Crawler 300 Hp.	5	86,000	24	20,417	22	19,000
Front End Loader 100 Hp.	5	31,000	24	7,360	19	6,000
Fuel Supply	5	5,000	24	1,187	8	400
Scale	10	11,000	14	1,495	14	1,500
		$191,000		$44,229		$40,700

PERSONNEL COSTS TABLE B

Supervisor & Scale	1 @ 2080 @ $8.2/Hr.	$17,056
Laborer	2 @ 2080 @ $4./Hr.	16,640
Equip. Operator	2.5 @ $11.50/Hr and 2080 Hrs.	59,800
		$93,496

FACILITY COST ESTIMATE TABLE C

		YR.	CC	@%	AC
1.	Design	25	$20,000	8	$ 1,565
2.	Site Preparation	25	30,000	8	2,347
3.	Building Facilities	25	21,620	8	1,691
4.	Equipment	Varies	191,000	-	44,229
	Sub-Total		$262,620		
5.	Supervision & Inspection	25	10,982	8	879
	Sub-Total		$273,602		
6.	Contingency - 10%	25	27,360	8	2,189
	Sub-Total		$300,962		
7.	Legal 3%	25	9,029	8	722
	Sub-Total		$309,991		
8.	Bond Discount 3%	25	9,299	8	744
	TOTAL CAPITAL COST		$319,290		$54,366

ANNUAL COST	
A. Lines 1-8	$54,366
B. Equipment	40,700
Facility 50% of CC-3	10,810
Miscellaneous 3% of CC-2	900
C. Salaries	93,496
Total Annual Cost	$200,272
Annual Unit Cost	$2.00/Ton

O&M- OPERATION AND MAINTENANCE
Yr.- NUMBER OF YEARS AMORTIZED OVER
CC - CAPITAL COST
@% - % CAPITAL RECOVERY PER YEAR
AC- ANNUAL CAPITAL RECOVERY VALUE

Table B-9

BASIC LANDFILL COST ASSUMPTIONS

5000 TPW

EQUIPMENT TABLE A

NO.	YR.	CAPITAL COST	%	OWNING	%	O&M
1. Crawler 195Hp.	5	$ 58,000		$13,770		$13,800
2. Crawler 300Hp.	5	86,000		20,417		19,000
170Hp.	5	52,000		12,345		12,000
1. Loader 300Hp.	5	31,000		7,360		6,000
1. Scraper 150Hp.	5	49,000		11,633		18,000
1. Truck Pick-Up	4	4,000	29	1,160	46	1,840
1. Fuel Truck	5	13,000	24	3,086	35	4,500
1. Water Tank Truck	5	12,000	24	2,849	35	4,000
Motor Grador	5	31,000	24	7,360	13	4,000
Scale	10	25,000		3,397		3,000
		$361,000		$83,377		$86,140

PERSONNEL COSTS TABLE B

5 Operators @ $11.50/Hr. @2080	$120,000	
4 Laborer $4.00/Hr.	33,280	
2 Scale Operator @ $11066./Year	22,132	Based on Ratio of Lab/Sc.Op.
1 Supervisor @ $17,000 @ $8.2/Hr.	17,000	Based on Ratio of Sc. Op/Sup.

FACILITY COST ESTIMATE TABLE C

	YR.	CC	@%	AC
1. Design	25	$ 25,000	8	$ 1,956
2. Preparation	25	40,000	8	3,129
3. Building Facilities	25	27,244	8	2,131
4. Equipment	Varies	361,000	-	83,377
Sub-Total		$453,244		
5. Supervision & Inspection	25	16,444		1,316
Sub-Total		469,688		
6. Contingency 10%	25	46,969		3,758
Sub-Total		$516,657		
7. Legal 3%	25	15,500		1,240
Sub-Total		$532,157		
8. Bond Discount 3%	25	15,965		1,277
		$548,122		$98,184

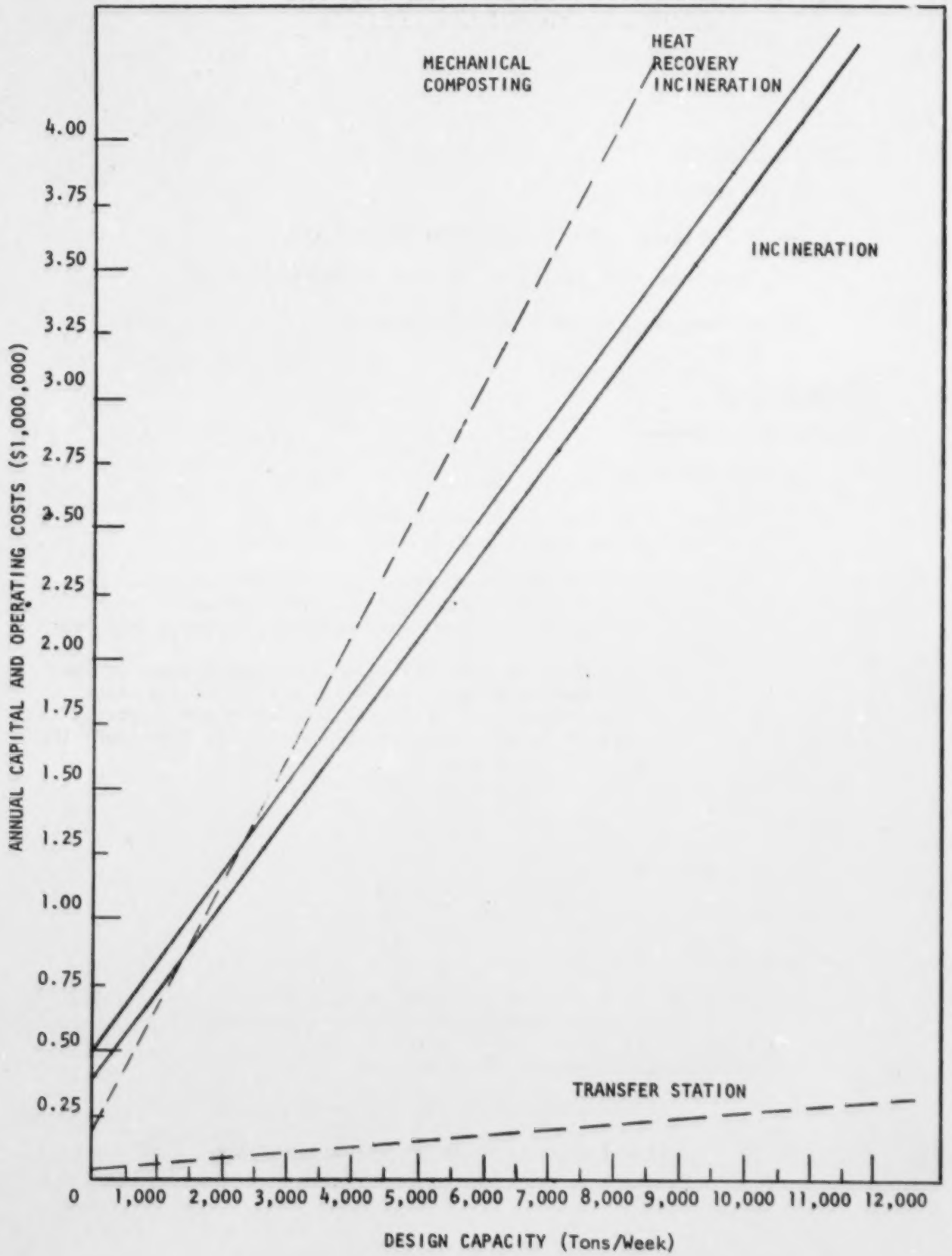
O&M - OPERATION AND MAINTENANCE
Yr. - NUMBER OF YEARS AMORTIZED OVER
CC - CAPITAL COST
@% - % CAPITAL RECOVERY PER YEAR
AC - ANNUAL CAPITAL RECOVERY VALUE

TABLE B-9 Continued

A.	Sum 1-8	$98,184
B.	Equipment	86,140
	Facility	13,622
	50% of CC - 3 Miscellaneous	1,200
	3% of CC - 2	
C.	Salaries	$192,412
	Annual Cost	$391,558
	Annual Unit Cost	$1.50/Ton

Figure B-2

COST FUNCTIONS: INTERMEDIATE PROCESSING FACILITIES



EQUATIONS FOR FACILITY COST FUNCTIONS

Transfer Station

$C = 22\ TPW + 40{,}000$

Where C = Annual capital and operating cost ($)

TPW = Design capacity of facility (tons/week)

NOTE: Does not include transport costs.

Compost Plant

Mechanical Digestion:

$C = 500\ TPW + 200{,}000$

Where C = Annual capital and operating cost ($)
TPW = Design capacity of facility (tons/week)

NOTE: 1) Cost of residue disposal not included. Approximately 15% of solid waste input must be disposed of when salvage is not practiced; 5% when salvage is practiced.

2) No credit is given for sale of the end product or the salvaged materials. Approximately 33% of the input quantity emerges as compost, and glass and ferrous salvage usually amount to 5% each of the input quantity.

Incinerator

Standard:

$C = 320\ TPW + 400{,}000$

With Power Production

$C = 340\ TPW + 500{,}000$

Where C = Annual capital and operating cost ($)
TPW = Design capacity of facility (tons/week)

NOTE: 1) Continuous - feed furnaces

2) Air pollution control equipment included

3) No credit is given for the sale of power

Sanitary Landfill

Capital Cost: Consultant's estimate for each individual case.

Operating Cost:

$C = 84\ TPW + 30{,}000$ when $TPW \leq 3{,}000$
$C = 38.5\ TPW + 160{,}000$ when $TPW > 3{,}000$

Where C = Annual operating cost ($)
TPW = Operating level (tons/week)

The curve that best fit the cost data is described by the following equation:

$$C = 0.62 \log TPW + 3.24$$

Since only linear equations are acceptable to the optimization routine, two linear equations were fitted to the curve aroung the specified breakpoint which yielded the two linear equations above.

RESOURCE RECOVERY FACILITY AND COST

The following system was designed to process up to 750 tons per day of municipal solid waste based upon a 2-shift operation. The system will shred all waste, magnetically separate ferrous metals and separate heavy and light fractions. Two shredders are provided to assure continuous service. The system will produce: shredded fuel, ferrous metals, and a mixture of glass and non-ferrous metals.

This estimate does not include the power plant handling and transportation costs. Included in the building cost is a pile foundation.

This system was designed in 1973 for the City of New Orleans by the National Center for Resource Recovery, but has not been constructed. The construction and operating costs included herein are unvarified estimates of cost.

TABLE B-10

FACILITY (750 Tons/Day, 2 Shift)

	MATERIALS	LABOR
Scale	57,375	6,715
Front End Loader	58,300	-
Municipal Solid Waste Conveyor System	201,235	14,740
Reject Bin (large objects)	6,985	-
Trommel Screen	143,185	11,120
Trommel Discharge Conveyor	12,445	19,085
Shredder Feed Conveyor	20,005	19,085
Shredder (2)	569,615	18,790
Shredder Discharge Conveyor	45,545	805
Air Classifier	270,960	42,190
Magnetic Separator	28,000	7,000
By-pass Conveyor	25,380	2,115
Shredder Materials Conveyor System	58,235	2,115
Heavy Materials Conveyor System	25,875	4,935
Electrical System	51,650	10,075
	$1,574,890	$158,770
Building, Receiving (1,000 Ton Storage)	182,880	14,590
Asphalt Apron	14,750	12,010
Shredder Building	113,305	79,500
	$ 310,935	$106,100
Engineering, Contingencies, Profit	510,385	
Total Cost	$2,661,080	

TABLE B-10 (Continued)

OPERATING COST

Amortization (10 Years @ 8%)

2,661,080 (CRF 10 Years @ 8%) 0.149 ÷ 12 =	45,500
Power, water	14,538
Shredding	23,469
Recovery	28,608
Cost per Month	$112,015

Total Annual Cost $1,340,000

750 Tons/Day x 6 Day/Week x 52 Weeks/year = 234,000 Tons/Year

Cost per Ton = $5.73

@ 500 Tons/Day x 312 Days/Year = 156,000 Tons

Cost Per Ton = $8.60